The ownership and management of fishery research vessels

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PREPARATION OF THIS DOCUMENT

In recent years FAO has received numerous requests from member countries for expert assistance during the various stages of planning for the procurement and operation of fishery research vessels. In rendering this assistance, FAO recognized the need for a comprehensive guide to cover the many aspects from the highly scientific to the technical and operational of this complex subject.

This paper is intended for the guidance of legislators, administrators and directors of fisheries institutions contemplating the ownership and management of research vessels and reviews the common problems and pitfalls generally encountered. It does not deal with such questions as: "What is a research vessel for?", or the scientific operations of such vessels. A separate paper covering these aspects is under preparation.

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ABSTRACT

The very high costs of owning fishery research vessels make it especially desirable to ensure that value is obtained for the money spent, in terms of sea time achieved and information produced. The authorities who own and manage such vessels face a number of peculiar problems in their design, procurement and operation which may not be easily solved by applying normal administrative principles and procedures. Factors affecting vessel availability and utilization, such as crew incentives and financial control of normal maintenance, are discussed, together with safety, insurance, legal matters, sale of catches and other aspects of ownership and management. Also discussed are other methods open to the fisheries authorities for acquiring information and experience that do not involve the ownership of a specialized research vessel.

PREFACE

One, or often more, well-equipped research vessels are both the pride and despair of a modern fishery research institute. They are the pride because they are the most obvious symbol of the institute's activities, and without such a vessel it would be difficult or impossible to make many of the observations that are the life-blood of its work. They are the despair because the costs and complexities of vessel operations have reached such levels that covering them leaves very little for carrying out the other essential functions of a research institute. These problems are especially pressing for many developing countries. The establishment of extended zones of jurisdiction has suddenly increased their needs to know about the resources off their coasts - for example, in reaching agreements with foreign countries wishing to fish in their EEZs - multiplying the demand for research and survey vessels.

The high visibility and symbolic status of modern research vessels have made them attractive to both the recipients and donors of international aid (the latter often also being mindful of the interests of their domestic ship-building industry). At the same time the pressures of increasing fuel and other costs have borne particularly heavily on developing countries. A not uncommon result has been that a developing country has been presented with a modern well-equipped research vessel, which has then not been used because there have been no funds to operate it. The gift of a research vessel worth five million US dollars may seem less welcome when the recipient comes to realize that it will cost between two and three million US dollars a year to maintain and operate such a ship.

These are not the only problems associated with research vessels, nor are the problems restricted to developing countries. Research vessels are relatively few, and few shipyards are used to building them. Since fishing is one of their jobs, they may be based on a well-established fishing vessel design, but the absence of commercial quantities of fish and ice below decks and the addition of heavy specialized winches and other scientific equipment high up on the ship is only one of a number of peculiar problems facing the designer. The day-to-day running of these vessels can involve many problems. There are operational problems of the correct division of responsibility between the captain - responsible for the navigation and safety of the ship - and the chief scientist - reponsible for the scientific work. The overall scientific work has to be carefully planned so that there is a proper balance between the work at sea collecting data, and the follow-up work ashore to work up the data. Many laboratories have numerous jars of samples stocked in their basements which are collected at considerable expense, but which have not been properly analyzed because the staff - some of whom may be busy at sea collecting more samples - have not the time to do so. There are problems in applying the principles of financial control and public accountability appropriate to government organizations while nevertheless ensuring that the vessels are available and ready-for-sea for a high proportion of the year and are effectively utilized.

It was with these varied problems in mind that several delegations at the 14th Session of FAO's Committee on Fisheries mentioned their continuing problems in regard to the selection, procurement and operation of research vessels, and the suggestion was made that FAO should provide unbiased advice on the planning, operation and management of fishery research vessels. This Technical Paper has been prepared in part-response to that suggestion. It does not claim to be a manual on the subject - if indeed it would be possible to prepare such a manual - but is intended to provide some general guidance to those operating or contemplating operating research vessels.

The potential activities of a fishery research vessel are varied, from collection of oceanographic observations, through sampling of biological organisms from phytoplankton or zooplankton to fish, and surveying of fish stocks to trials of new fishing gear, and the collection of fish for processing trials. In any case the observations made at sea, or the samples brought back to land, will be part of a research programme which will involve careful analysis of the data from the research vessels, and probably also of data coming from other sources. What those deciding on the acquisition of a new research vessel or on the operation of an existing vessel need to know is the importance of the research programme to the well-being of the national fishery (possibly at some point still some time in the future), and the degree to which the success of the programme depends on the observations from the vessel. Very often these are vital. Fishery research is concerned with what happens in the sea - with, say, the interactions between commercially useful fish and the animals on which they feed, or the behaviour of a trawl net being towed at different speeds. Some insight into these matters may be gained from experiments in laboratories ashore, but at some time direct observations at sea are likely to be necessary. Observations from a research vessel are, however, only a means to an end - the end being the research conclusions that can be used by the fishermen, fishery administrators or others.

All ships are expensive to buy, to operate and to maintain. Research vessels are exceptional only to the extent that they are more complicated, and also, because they are unusual ships, there is not, except in a few countries, any body of experience of the special problems involved. The problems start when the ship is being designed and built. Many types of work will normally have to be carried out - operation of a variety of commercial types of fishing gear, hydrographic gear and plankton nets, and storage and often preliminary analysis of the samples collected, for each of which the scientists immediately concerned will usually demand appropriate space, winches, laboratories, etc. Even if only part of these requests (usually expressed by the scientist concerned as the minimum without which he cannot reasonably be expected to do his work) are complied with, the ship can easily grow to an enormous size and complexity. This problem is made worse by the fact that few shipyards or naval architects are familiar with fishery research vessels, and therefore find it difficult to judge what is really needed. Even in the best of circumstances, the result is likely to be a large and expensive ship which, moreover, may be twice as costly as a normal fishing vessel of comparable size.

The building of a new vessel, or the purchase of a secondhand vessel, represents only the start of the expense and problems. The rapid rise in oil prices since 1972 has underlined the contribution of fuel costs to the general expense of owning and running a research vessel, but fuel is only part of the expense. A ship is a sensitive piece of equipment, and needs continued maintenance to be kept in working order. If these costs, and the costs of keeping a permanent crew (almost essential for the efficient running of the ship) are taken into account, the real costs of a research vessel tied up in harbour are not much less, if any, than those of a vessel at sea.

If, therefore, the high capital and running costs are to be justified, it is important that the ship is at sea and working for as long as possible. What should constitute a reasonable target, in terms of numbers of days at sea, will depend on the nature of the work (e.g., whether a lengthy stay in port between voyages is necessary to change equipment), on the weather (in some areas the monsoon, or other prolonged periods of high winds can cut many weeks out of the possible working season) and other factors. It would not be reasonable to expect a research vessel to achieve the same number of sea-days per year as a commercial vessel, which may be 300 or more; in favourable conditions - the weather suitable for year-round operations, good port facilities for quick turn-round, etc. - a target of 200-250 days would probably be realistic. Elsewhere it may only be feasible to aim at, say, 150-200 days. If it is not possible to achieve as much as 150 days, and certainly if the total falls much below 100-120 days, there must be a serious question whether the circumstances justify the ownership and operation of a research vessel and whether the research would be better carried out in some other way.

There are, in fact, many ways in which a fishery scientist can get to sea to make his observations without the institute to which he belongs having to own and run its own research vessel. Research vessels may be chartered for longer or shorter periods. A charter of an existing vessel for a year or two to carry out a survey will often be a much quicker, cheaper and more effective way for a developing country to collect the basic information about the fish stocks off its coast than buying a research vessel of its own. The experience gained in vessel operations will, in addition, be invaluable in deciding whether in fact a full-time vessel is required.

Shorter-term charters, or similar arrangements to use a research vessel from another institute (possibly in another country) for periods of one or two months, are invaluable for institutes with small staffs and small budgets. These may well not be able to afford or justify a full-time vessel. Equally the institute owning the vessel may be very glad to find a use for the vessel when it would otherwise be unoccupied, and thus to be able to spread the overhead costs more widely. The arrangements might be on an ad hoc, voyage-by-voyage basis, but could be part of a more formal agreement whereby the use of a vessel is shared between a number of institutes. A country with a number of universities and other research institutes concerned with fisheries and marine research in general, may well find it convenient to operate a central vessel pool. Smaller countries, especially developing countries, may find it convenient to share a vessel between several countries. This may involve a formal agreement on sharing costs and deciding on operational plans for each year. It may involve a less formal understanding that a research vessel of one country will be available for regular chartering by institutes of adjacent countries. This approach has advantages even when many of the countries involved could expect to be able to operate their own research vessels. Instead of each country attempting to own and operate a vessel capable of undertaking all possible research work (which is an impossible design task), each country could aim to operate a more specialized vessel, of a type particularly suited to the national needs. At the time of writing, FAO is carrying out a feasibility study on behalf of UNDP into such methods of making more efficient and effective use of existing research vessels. Such arrangements should facilitate increased technical cooperation between developing countries (TCDC) in particular.

Research at sea does not necessarily require a specialized research vessel. Much can be done equally well on board normal commercial fishing vessels, and some, e.g. tests of modified fishing gears, are better done from commercial vessels. At the simplest and cheapest this may involve no more than placing a scientist or engineer on board the vessel during a normal commercial fishing trip to make observations on, for example, the number and species of fish discarded, or to collect biological samples (stomach contents, etc.). Under favourable conditions tagging experiments can be done in this way (payment being made for any fish tagged and released), but more usually the need to handle the fish carefully, and to tag fish in pre-determined times and places,will make it necessary to charter the vessel.

Chartering will be necessary for most other purposes for which commercial vessels are suitable - for gear trials, to carry out surveys beyond the normal areas fished, etc. This will not be cheap. It is desirable to use one of the better vessels in the fleet and, to ensure that the research scientist has full control over where, when and how the fishing is done, with the full collaboration of the skipper and crew, the terms of the charter will generally have to guarantee a return equal to a good fishing trip. However, since these costs will only cover the period when the ship is actually needed and used, they will be considerably smaller than those involved in running a full-time research ship.

There are other advantages in using commercial fishing vessels. Effective fishery research must involve close links between those doing the research, and the actual fishing community. These are needed in many ways: so that the research is directed towards the real problems of the fishery; so that those in the fishing industry have a reasonable understanding of what research can, and cannot do, and so that the scientists can properly interpret the statistical and other data coming from the commercial fishery. If the scientists go to sea on commercial vessels, and some of the fishermen are involved in the research work, these links will be strengthened.

All these subjects are discussed at greater length in the following chapters, which are based on the experience gained by FAO over the years in operating a fleet of research vessels as well as on the experience of member countries. The paper is intended for the guidance of legislators, administrators and directors of fishery research who are contemplating the ownership and management of research vessels. Inevitably it can discuss only some of the more common pitfalls and problems that are encountered, and these only in a general way. FAO is, of course, willing to provide advice on specific situations in particular countries, on request, and on special topics such as chartering and insurance.

CONTENTS

Page

1. SCOPE 1

2. PRELIMINARIES TO PROCUREMENT 1

2.1 Functions of Research Vessels 1
2.2 Justification for Research Vessels 3
2.3 Identifying the Requirements 4

3. DESIGN CONSIDERATIONS AND THEIR IMPLICATIONS 5

3.1 Vessel Type 5
3.2 Designer and Builder 5
3.3 Special Design Problems 6
3.4 Permanent Fixtures and Permanently-Dedicated Spaces and Services 7
3.5 Diverse and Conflicting Requirements 8
3.6 Individuality of Design and its Cost 9
3.7 Special and Unorthodox Features 10
3.8 Inappropriate Features and Requirements 12

4. PROCUREMENT 13

4.1 General Procedure 13
4.2 Some Administrative and Financial Points 15
4.3 Technical Advice and Assistance 18
4.4 Secondhand Vessels 19
4.5 Other Incidental Costs 19
4.6 Owner's Supply Items 20
4.7 Additional Spares 20

5. OWNERSHIP; SPECIAL RESPONSIBILITIES AND LIABILITIES 20

5.1 Legal Ownership 20
5.2 Special Responsibilities of Owners 21
5.3 Special Liabilities and Risks 21

6. SAFETY 22

6.1 General Considerations 22
6.2 Standards of Construction and Maintenance 23
6.3 Transverse Stability 23
6.4 Special Risks 24
6.5 Safety Equipment and Procedures 24
6.6 Daily Reporting 25

7. COSTS OF OPERATION 26

7.1 Operating Costs of Fishery Research Vessels 26
7.2 Standards of Maintenance 26
7.3 Laying-up out of Service 27
7.4 Repair and Maintenance of Scientific Equipment 27

8. UTILIZATION AND AVAILABILITY 28

8.1 Utilization 28
8.2 Availability 28
8.3 Planning and Control 29

continued:

Page

9. FLEET MANAGEMENT: OBJECTIVES AND RESOURCES 29

9.1 Objectives 29
9.2 The Fleet Manager 30
9.3 The Management Team and its Functions 30
9.4 Other Essentials

10. FLEET MANAGEMENT: ADMINISTRATIVE AND FINANCIAL CONSIDERATIONS 32

10.1 Provision of Finance 32
10.2 Policies and Procedures 33
10.3 Spares and Service 35
10.4 Crew Incentives 35
10.5 Incentives for Scientists 36

11. OFFICERS AND CREW 36

11.1 The Master 36
11.2 The Masterfisherman 37
11.3 Relief Officers and Crew 37
11.4 Discipline 37
11.5 Pay 38

12. SALE OF CATCHES

12.1 General Considerations 38
12.2 Advantages 39
12.3 Problems 39

13. MARINE RISKS: INSURANCE 40

13.1 General Considerations 40
13.2 Technical Considerations 40
13.3 Example 41

14. LEGAL MATTERS 41

14.1 Ownership 41
14.2 Status of Vessel 41
14.3 Exemptions 42
14.4 Enabling Legislation 42

15. OTHER METHODS OF PROVIDING SEA-GOING FACILITIES 42

15.1 General 42
15.2 Use of Commercial Vessels 43
15.3 Research Vessel Pools 44

16. CONDITIONS FOR EFFECTIVE UTILIZATION

16.1 The Research and Development Function as a Whole 44
16.2 Successful Utilization of Research Vessels 45
16.3 Supporting Services 45

1. SCOPE

1.1 Owning ships carries with it certain peculiar responsibilities; the management of a fleet of ships, however few in number, is a difficult professional art. It is especially difficult in the case of research vessels because the vessels are complex, and their design and operation are subject to the requirements of scientists and technologists some of whom may have little appreciation of many of the considerations that will be uppermost in the minds of designers, builders, managers and masters of ships. Not only may some scientists have little seagoing experience or knowledge of nautical matters, but also most fishery research vessels are owned by governments or public bodies and operated by departments or agencies of state in which few of the officials, especially senior officials, are likely to be familiar with ships and the sea. The attitudes and practices of other departments of state, more accustomed to owning and managing ships, may be illsuited to the effective operation of fishery research vessels. Standard government administrative and financial rules and procedures may be inappropriate or inadequate for effective procurement and utilization of fishery research vessels, yet these are very expensive items of capital equipment.

This technical paper discusses some of the more common situations and difficulties in which government organizations may find themselves in the course of the procurement and operation of fishery research vessels, especially if they have little or no previous experience. It embraces the very wide range of topics with which owners and managers of research vessels have to deal - legal, scientific, technical and political; insurance, safety at sea, standards of construction and maintenance; availability and utilisation of the ship; provision for maintenance, repair and refit; disposal of catches; qualifications of officers and crew, manning scales, discipline, pay and incentives; relationship between ship's officers and scientists; supporting and complementary services; costs of procurement and operation; roles of consultants, classification societies and maritime authorities; and so on.

1.2 Some space is also given to the possibilities of procuring sea-going facilities and retrieving information from the fishing grounds without necessarily incurring the heavy costs of owning and operating a research vessel; the circumstances in which such alternatives may be appropriate are outlined. Another option discussed is the purchase and conversion of second-hand vessels. Attention is drawn to the differing operational and financial responsibilities, for equipment installed on board the vessel, of the management, officers and scientific staff respectively.

1.3 The paper also includes some remarks on design philosophy that may help to prevent enthusiastic but inexperienced scientific and technical staff from repeating some of the mistakes of the past.

1.4 The first step in acquiring a research vessel, however, will normally be to justify the expenditure to those who will advise and decide on the provision of funds for its procurement and operation. It is therefore necessary to consider again, briefly, from this point of view, the purposes for which research vessels are built, how the need may be defined and met, the kinds of benefit that are likely to accrue and whether there are means, other than by acquiring and operating research vessels, whereby the same ends can be served.

2. PRELIMINARIES TO PROCUREMENT

2.1 Functions of Research Vessels

2.1.1 Often, the purposes for which a research vessel is built can be equated with, or related to, the functions and objectives of the research establishment or university department to which she is to be permanently allocated. Research vessels, however, are not always owned and managed by the organizations that use them: for example, the fisheries development projects carried out under the auspices of the United Nations Development Programme normally charter research vessels from the UNDP Research Vessel Pool managed by the Fisheries Department of FAO. There are also other ways of acquiring sea-going facilities, when they are needed, without owning a research vessel. For the moment, it can be noted that fishery research and development organizations may be able to fulfill some of the objectives of their sea-going programmes without using research vessels. To what extent this is possible depends partly upon technical and operational considerations, partly upon the general style and philosophy of the research establishment and partly upon whether there exists a commercial fishing fleet able and willing to provide facilities for research and development workers on board. These questions are discussed later below (Chapter 15).

2.1.2 Much, but by no means all, of the research carried out at sea in support of the fish industry is intended to enable assessments to be made of the sizes and potential yields of the various stocks of fish that make up the economic resource upon which the commercial fishery depends; to assess the state of exploitation of these stocks; and to examine the oceanographic and other factors affecting the well-being of the fisheries. This kind of investigation is normally a continuing one, although the demands on research vessel time will vary according to local circumstances and the availability or otherwise of reliable information on the operations of the commercial fleets.

Other kinds of sea-going activity in the fields of research and development are usually more spasmodic and take place as problems arise or as opportunity offers. They include exploratory fishing; development of new or improved methods of capture; and development of new or improved methods of handling, processing, storage and preservation of the catch. There may be a continuing demand for raw material of known provenance and history for use on shore in developing new handling and processing methods and new products. From time to time there may be sea-going investigations of factors affecting product quality, hygiene and edibility.

2.1.3 One other function is sometimes carried out: the training or retraining of a few selected commercial fishing skippers and masterfishermen in new techniques or in the use of new equipment. It is not practicable, on the other hand, to design and equip a vessel intended for serious research so as to make it also suitable for use in the basic training of large numbers of fishermen. The use of expensively-equipped research vessels for this purpose is in any case almost certainly uneconomic.

2.1.4 Often, the size of the national fish industry and the economic circumstances of the country will justify only one research vessel; or else the authorities may have decided to gain experience with a single vessel before acquiring others; or else the coastline is so long that single vessels have to be deployed at local regional centres. In all these cases, a single research vessel may be called upon to fulfill any or all of the functions noted above.

Whether it is practicable to carry out all the various activities in one research vessel depends, among other things, on the diversity of the national fish industry and the range and scale of its operations. It may be necessary, for example, to operate in both coastal waters and offshore waters, and perhaps also in very distant waters such as the Southern Ocean. The most suitable vessels for these various different areas of operation will be of very different size and cost, but each may well have to be a multi-purpose vessel, depending upon how many fisheries research vessels can be justified by the socio-economic circumstances of the national fisheries.

Depending on local circumstances, problems and opportunities, a single vessel may have to possess the capability for carrying out work in fisheries biology; acoustic surveys; fishing technology; fish handling, processing and preservation; exploratory fishing. It may have to be capable of employing a number of different methods of capture and preservation on several different groups of species. However, in cases where the national fisheries research vessel fleet is large, more specialized vessels are sometimes found: in the United Kingdom fisheries research vessel fleet, R.V. G.A. REAY is equipped primarily for work on handling and processing. The Federal Republic of Germany's research vessel WALTHER HERWIG has sometimes been used for general resource work but was designed and equipped with development of trawl gear in mind. The more specialized the vessel, the less likely will she be capable of effective and efficient work in other fields; on the other hand, the problem in specifying and designing a multi-purpose vessel is to ensure that she will be reasonably effective in any field at all.

2.1.5 It is all too common, however, when drawing up the operational requirements for a new research vessel, for the assumption to be made that she is primarily or exclusively for the use of those concerned with stock assessment and problems related to the resource, and to forget that there is at least the possibility that work will have to be done from time to time in the field of fishing technology and in handling and processing. This occurs even in cases where the fisheries biologists, the fishing technologists and those working in the fields of food science and technology as applied to fish, are grouped into a single, comprehensive fisheries research and development organization under unified control. This can be due partly to the fact that the need for those concerned with handling and processing to be active at sea is occasional, and they can usually find plenty to do without going to sea, although one of the local problems may be the poor quality of the commercial catches at the time of landing.

It may therefore sometimes be necessary for those attempting to discern and define the purposes for which a fishery research vessel is deemed to be necessary, to make a deliberate effort to ensure that the possible future needs in the field of fishing technology and in fish handling, processing and preservation, are being taken into account.

2.2 Justification for Research Vessels

2.2.1 Not all of the work in the fields of research and development that must be done at sea, or should be done at sea, need be done in research vessels. Much can sometimes be done by procuring facilities from the commercial fleet or in other ways; there is a strong case for preferring this method of working in certain fields, and this topic is discussed more fully in Chapter 15. Meanwhile, it should be noted that fishery research vessels are expensive in both capital and operating costs and their use is not always the most effective way of obtaining and disseminating the desired results, especially in those cases where these may be of direct operational interest to the fishing industry.

2.2.2 In the field of stock assessment, arriving at the first more or less reliable estimates of biomass and sustainable yield during the early years of a new fishery may require the intensive use of a research vessel. Later, however, depending upon the species in question and on other factors, it may become possible in some cases to rely to a large extent on other means of assessing the state of exploitation of the stocks, as for example in demersal trawl fisheries. In other cases, the intensive use of a research vessel for at least several weeks a year may still be highly desirable and effective, as for example in the assessment of stocks of pelagic shoaling species by acoustic survey. In both cases, however, the requirement for the use of a research vessel may diminish after some years and it may be found, in due course, that a research vessel originally procured for such purposes still has several years of useful life remaining but that there is a diminished real demand for her services, at least in connection with stock assessment; however, there may well be demands related to other objectives now of higher priority. It is desirable, when considering the acquisition of a research vessel, especially a new vessel, to satisfy one's self that there will be a continuing demand for such a facility after not just five or ten years but after fifteen or even twenty years - many fishery research vessels remain in service longer than that. Otherwise charter, or provision of a vessel through technical assistance for a few years, may be the answer.

2.2.3 In some countries the justification for acquiring a fishery research vessel may be found partly in the desire to acquire more information on the size and potential value of the resources available within the national fishery limits, or accessible to the national fishing fleets. In such cases, some kind of cost/benefit study, relating the value of the additional resources discovered (or new opportunities for diversification of effort) to the costs of the research vessel and the associated shore laboratories and services, may be valid. However, in the nature of things it will be difficult to estimate the benefits before the event. It would be unwise in most cases to acquire a research vessel for the sole purpose of detecting large unknown resources as such generally do not exist.

What is desirable in such cases is some assurance, on general biological or oceanographic grounds, and drawing on any fishing information available from other sources, that the possibilities of expansion or diversification are real, and not based on mere wishful thinking by commercial vessel operators desirous of new fishing opportunities, or by a government faced either with the problem of a fishing fleet no longer economically viable or with the need for additional food supplies.

2.2.4 The biggest concentrations of fishery research vessels, fishery scientists and technologists are, however, to be found in and around those sea areas where the fisheries are mature and there are comparatively few possibilities of expansion or diversification. The justification for these research vessels and the programmes of research and development they are intended to serve is that they will help to insure against overfishing and over-investment; that they will help to provide a capability to respond to changes in the environment in which the national fish industry has to operate (natural, economic and political); and that they will help to improve the economic performance and efficiency of the fish industry.

2.2.5 It is not sufficient justification for acquiring a new research vessel to state that "the R.V. WHATNOT is now 20 years old and needs to be replaced" or that the new vessel is being offered as a gift. Nor is it really sufficient to justify the research vessel by reference to the objectives of the research and development programme; it should also be made clear that the alternative means of providing sea-going facilities for the research and development workers, discussed later below, are inappropriate or inadequate.

2.3 Identifying the Requirements

2.3.1 An early step in the procurement of a new research vessel should be to draw up a statement of operational requirements. This will include, for example, and among other things, a statement of the methods of capture that it should be possible to employ; the numbers of scientists and technologists to be embarked; power, range and endurance; the extreme conditions of climate and weather to be faced; special technical features and scientific equipment to be built into the ship; laboratory space required; requirements and constraints regarding layout; storage space and fish holds; special local requirements and constraints; preferences regarding types of machinery, etc.; standards of construction; suggestions regarding overall length, breadth, depth and draught, hull form, etc.

This will form the basis upon which consulting naval architects can draw up a specification and a preliminary general arrangement drawing for discussion with shipbuilders, and also for the purpose of inviting tenders (bids) if this is deemed necessary or desirable.

2.3.2 The statement of operational requirements should be drawn up in conjunction with the scientists and technologists who are the potential users of the vessel.

In the case of a vessel belonging to a pool with a professional marine superintendent and superintending engineers, the most senior professionally qualified engineer of the research vessel pool management should draw up the statement of operational requirements in conjunction with the potential users.

In the case of a vessel that is to belong completely to one research or development organization, the discussion of their perceived requirements with the various potential users, collating and reconciling them and preparing an agreed statement of operational requirements, should be the responsibility of a scientist or technologist with sufficient seniority and breadth of experience to enable him to appreciate the requirements of the various users and whose judgment will be accepted by them as final. Ideally, he should have had previous experience in planning a research vessel.

If, in the second case, the staff of the research organization includes a professionally qualified marine superintendent or superintending engineer with experience of the management, operation and maintenance of research vessels, he should take part in all discussions with potential users and in drawing up the final statement of operational requirements. His input should include drawing the attention of the reader to the technical implications, in terms understandable by and familiar to naval architects, marine engineers and shipbuilders. If the services of such a person are not available, technical assistance should be sought in the form of providing the services of a consultant who has wide experience in sea-going research or development in the field of fisheries and considerable experience in the planning, procurement and operation of successful fishery research vessels. Another very desirable qualification is an engineering background so that he can draw attention, as already suggested, to the technical implications of the operational requirements, in terms that will be understood by the designer and builder.

2.3.3 The preparation of a statement of operational requirements should be a separate and distinct procedure from the preparation of the outline specification and preliminary general arrangement.

The latter should be done by naval architects, either independent consultants, or the design staff of the chosen shipbuilder, as may be appropriate. Such people are designers of ships; they are not familiar with the purposes or techniques of fishery research and development and therefore would not be able to provide constructive criticism of operational requirements suggested by individual specialist users of the vessel. In the worst cases, they would accept all proposals and produce a design that attempts to satisfy every statement of requirements put forward by the scientists and technologists; this may lead either to a very large and expensive vessel, or to a design that is so compromised by the attempt to cater for all demands that the vessel is impracticable or ineffective in most of its roles. To avoid these situations, the procedure recommended earlier, of preparing an agreed statement of operational requirements for the guidance of the designer, should be followed.

More will now be said about the general approach to design and the most practical and effective ways of catering for the requirements of the research and development workers.

3. DESIGN CONSIDERATIONS AND THEIR IMPLICATIONS

3.1 Vessel Type

3.1.1 The main characteristic that distinguishes fishery research vessels from oceanographic or hydrographic vessels is that they are designed and equipped to use full-scale fishing gears, probably of several different kinds. This capability is essential for certain kinds of scientific investigation and technical development work. Moreover, if a research vessel is not at least potentially capable of fishing like a commercial vessel, the industry will find it all the more difficult to place much faith in the results of the research or development. For the same reason, the seaworthiness and weather tolerance of a fishery research vessel must be at least equal to those of the local commercial fishing vessels.

3.1.2 It follows that, as regards hull form and propulsion characteristics, the design of a fishery research vessel should be based on that of an appropriate type of commercial fishing vessel. There is no point in adding imposing-looking deck machinery and electronic equipment to a basically unsuitable hull.

Basing the design on an appropriate type of commercial fishing vessel will furthermore ensure that the research vessel constitutes a stable and dry working platform - one of the prime requirements.

3.2 Designer and Builder

3.2.1 Several things follow. First, the designer must be familiar with the appropriate types of fishing vessel and with how to achieve the desired fishing performance and behaviour in a seaway; he must also be familiar with current good practice in the choice of the various important design parameters and with the normal equipment of commercial vessels of the type. That is to say, the choice of the designer of the research vessel should be restricted to people or organizations who have a recent record of designing successful commercial fishing vessels of the appropriate size and type. In some countries, such experience is to be found mainly in the shipyards which specialize in building fishing vessels.

3.2.2 Second, it is very highly desirable to restrict the choice of shipbuilder in a similar way, to yards that have a recent record of constructing successful commercial fishing vessels of appropriate size and type.

3.2.3 Naval architects and shipbuilders, even if they specialize in designing and constructing commercial fishing vessels, are not generally skilled in the arts of fishing. When it comes to the choice of deck machinery and the placing of the machinery and other deck equipment when the ship is being fitted out, it is customary for guidance to be provided by the owner, or by a consultant fishing technologist acting on the owner's behalf. Some fishery research establishments have knowledgeable and experience masterfishermen on their staffs, some have fishing technologists; otherwise it is desirable to engage a qualified consultant.

3.2.4 The designer and builder of the research vessel will probably know little or nothing about the methods and equipment employed by the scientists and technologists in the course of their work at sea: so few fishery research vessels are built that it is not likely that they will have had any previous experience of designing and building them. It is therefore necessary to provide guidance on choice and fitting of such equipment as scientific sonars, scientific sounders with echo integrators, oceanographic winches and so on, and on the layout and fitting of laboratories.

A short study tour to familiarize the designer with existing fishery research vessels and their operation will be useful but the main guidance to the designer on the scientific and technical equipment and the fitting and layout of the laboratories will have to come from the users. If they have insufficient knowledge and experience, more experienced users should be consulted.

3.3 Special Design Problems

3.3.1 A commercial fishing vessel is designed to be able to bring a catch to port in a safe manner. Depending upon vessel size and type, and the fishery in which she is engaged, the combined weight of the catch and the ice or other means of preservation, may amount to a quarter, a third or an even higher fraction of the total displacement. Generally, as the ship consumes fuel, water and stores in the course of a voyage, fish is coming on board, so that the total displacement may not change very much, nor will the transverse stability, trim and freeboard be much affected if the design is good. A research vessel, on the other hand, may often return to port after a long cruise with little or no fish on board. In some designs of fishing vessel, the transverse stability and trim may then be approaching the unacceptable.

Because of this, there is a temptation to modify the hull form so as to reduce the problem of maintaining adequate transverse stability in both the departure condition and the arrival-in-port condition, which at the same time may reduce displacement and improve the calm-water free-running maximum speed. This temptation should be resisted: it will compromise the fishing performance, probably also the rough weather performance and the stability and dryness of the working platform. If the stability and trim in the condition of arriving in port after a long cruise with no fish catch, as predicted by calculation, are deemed unacceptable, then arrangements for taking on seawater ballast should be provided. The provision of space for large quantities of liquid ballast in vessels commanded by masterfishermen is a practice to be avoided wherever possible, because such people are preoccupied with too many other things always to pay sufficient attention to the state of the ballast tanks; therefore when it is decided to provide them, some thought should be given to arranging them so as to provide as little opportunity as possible for inadvertent misuse. See also 6.3 below, in which transverse stability is discussed.

Permanent solid ballast, on the other hand, may be required in order to bring the chosen hull form down to the desired displacement at the desired trim; this is a characteristic of certain types of fishing vessel and does not in these cases imply poor design.

Some quasi-permanent solid ballast is also desirable to compensate for the inevitable accretion of weight over the years: an even bigger problem in research vessels than in ercial ones. This ballast should ideally be placed at main deck and upper deck levels.

3.3.2 Insofar as a fishery research vessel is a commercial fishing vessel carrying, in addition, scientists, laboratories and special equipment, there may be a problem of space. This is not always completely solved by reducing the size of the fish hold or eliminating it completely; there is often a demand for space for additional acoustic apparatus and other equipment not carried by the commercial vessel. Another reason is that there is a strong case for the laboratories, or at least the wet laboratory where fish is handled, being on the fishing deck level.

The problem of space on the working deck is exacerbated by the requirement to be able to use more than one method of capture, and the need for space to handle such equipment as plankton nets, towed bodies and instruments deployed from the oceanographic winches.

The result is that in many fishery research vessels, the main working deck is cramped and crowded with equipment, while the deckhouse and superstructure are larger than in the corresponding commercial fishing vessel.

The latter result is particularly unwelcome because it makes it more difficult to bring the ship's head up into the wind when carrying out fishing operations and other manoeuvres; it increases windage and therefore makes it more difficult to handle purse-seines in conditions of wind, or to maintain position over a fixed point on the sea-bed when carrying out certain kinds of observations using an oceanographic winch.

A cramped working deck has obvious disadvantages and these are especially apparent when carrying out development on fishing gear and methods of handling it, when testing methods of handling the catch on deck or when attempting to simulate the conditions on the deck of a commercial vessel for whatever purpose.

To avoid these problems it is desirable to pay strict attention to space-saving. The provision of cabins for chief scientists and separate messrooms or even cooking facilities for officers, crew and scientists will exacerbate the problems. One way in which they may be solved is to reduce the number of officers and crew to the minimum by eliminating the need for a radio officer; by providing such features as bridge control of propulsion; by equipping the engine room for unmanned or partially-unmanned operation; and by a higher degree of mechanization on the fishing deck than might be justifiable operationally or economically in the corresponding vessels of the commercial fleet. Allocation of accommodation space should be closely related to the time spent on board by scientists and technicians, the average trip duration planned, and the need for undisturbed work spaces for such personnel.

3.4 Permanent Fixtures and Permanently-Dedicated Spaces and Services

3.4.1 Certain kinds of special equipment and facilities, if fitted, by their very nature have to be built into the ship; they include scientific acoustic apparatus; lateral thrusters; accurate measurement of propulsive thrust and torque; refrigerating condensing units; air conditioning. To fit any of these retrospectively would require major modifications to the vessel and would be very expensive.

3.4.2 Such items, however, should be exceptions to the general rule that the main objective in designing the scientific spaces and the areas where pilot plant and the like may be installed, is to provide the maximum of useful, uncluttered space which can be devoted to various purposes over the years, and perhaps to different purposes according to season or even from voyage to voyage. There should be a minimum of permanent sub-division of these spaces and a minimum of permanent dedication to a single purpose.

The reasons are first, that space will be scarce and second, that it is not wise to assume that the spaces for scientific and pilot-scale work will be used for exactly the same kind of thing, or be equipped in the same way, throughout the twenty or so years of the useful working life of the ship.

Thus, for example, the provision of chilled or frozen storage facilities for biological samples - as opposed to stowage of fish catches - is better done by installing portable domestic-type horizonal chest refrigerators, than by building permanent partitions in the laboratory space, insulating them and providing the necessary refrigeration. The removal of such a structure would be expensive and difficult; given the necessary access in the form of hatches, companionways and doors of adequate size, the installation and removal of refrigerated cabinets is simple, and the space is available for other purposes whenever wanted. Moreover, repair can be by replacement.

Consideration can even be given to portable modules equipped for various scientific tasks.

3.4.3 For the same reasons it may not be wise to specify pilot-scale processing plant and instal it in the ship at the time of building. Here again, the problems and the methods change over the years. Thus, it may be wise to provide a very flexible source of refrigeration (condensing units, surge drums and liquid refrigerant pumps) and also to insulate and line the fish hold space and provide cooling surfaces so as to allow operation at temperatures down to minus 30°C or lower, but it may not be sensible to build into the ship any particular form of quick-freezing plant: this can be installed as and when particular research and development projects are formulated. Similar considerations apply to other types of pilot-scale processing plant.

What must be provided is a capability to generate sufficient electrical power, and perhaps also sufficient process steam and fresh water, to allow any likely pilot-scale processing plant to be operated.

3.4.4 One reason for the tendency to specify built-in equipment and to dedicate a space for a single purpose is the conviction of some enthusiastic but less-experienced scientist or development worker that present research interests, present methods and present equipment will still be in vogue in several years' time. This is often not the case.

A second reason is that, if the equipment is portable, it will be charged - as is right and proper - to the research budget; if it is a permanent built-in fixture, it will be provided as part of the ship within the ship's overall cost. There is therefore a tendency to acquire scientific equipment by including it in the specification of the ship.

3.4.5 Caution should be exercised in acceding to stated requirements for a wide variety of common services, such as for example, electrical supplies of several different voltages, frequencies and numbers of phases, or for especially-stable voltage and frequency. If, on investigation, there is a genuine general demand for a supply different from the normal shore domestic supply, well and good; otherwise, people with apparatus requiring special supplies should be expected to provide their own stabilisers, converters, inverters, transformers, etc. (See also later below - 6.4.1 - regarding safety of laboratory supplies.

3.5 Diverse and Conflicting Requirements

3.5.1 When the fishery resources are diverse, the programme of research and development will include a number of very different seagoing activities. If there is only one research vessel, it has to perform a number of different functions. There is a real danger that the statement of operational requirements will call for the performance of functions or provision of facilities that are incompatible in a single ship; the attempt to meet all requirements may result in none of them being met effectively.

3.5.2 For example, if the vessel is to function primarily as a trawler in the open sea in considerable depths of water and in rough weather, she is likely to draw too much water to be able to work also inside an estuary with depths of 5 metres or less. The correct decision in this case is to acquire - or charter - a much smaller vessel for the work in shallow waters.

3.5.3 There are certain methods of capture that require knowledge and skills that are to be found only in certain fishing communities in particular parts of the world. For example, although skilled trawl fishermen can be found in many countries, the same cannot be said of certain kinds of longline fishing, or of some of the ways of fishing for squid, or of bottom-seining, to name just a few examples. Such methods also require special equipment including special deck machinery, and are most effective when used by fishing vessels with special features.

It may be that in some instances the fisheries authorities will wish to investigate at some time in the future the use of such methods and equipment. However, there may be little point in making any special provision for such possible activities when designing a research vessel, especially if this would mean either additional complexity or the making of doubtful compromises. The over-riding consideration is that some methods may be investigated best by employing a masterfisherman skilled and experienced in their use, and probably also a number of skilled and experienced key members of his crew; it then becomes more practicable, and more effective, and the results will be more convincing, if a specialised vessel is chartered for the work, complete with masterfisherman and crew.

3.5.4 More generally, it has to be accepted that only when the fishing is for one type of species in one particular range of depths and one typical sea area is the research vessel likely to be the appropriate vehicle for all the possible seagoing activities of the research and development team. When the fisheries and the fishing grounds are more diverse and dispersed, it will be unwise, if not technically and operationally impracticable, to attempt to design the vessel to meet every possible requirement. It should instead be designed to meet the main requirements efficiently and effectively, and the other requirements should be met if necessary by chartering or acquiring other, more suitable vessels.

3.6 Individuality of Design and its Cost

3.6.1 Nearly every fishery research vessel in the world is a unique, custom-built design: there are very few sister-ships, yet from the foregoing, it is hard to escape the conclusion that most of them share certain characteristics, so that there is a definite vessel type, the fishery research vessel. They differ in size and in the type, complexity and elaboration of equipment but not very much in basic characteristics.

Nearly all are single-screw, as are nearly all commercial fishing vessels; many are basically trawlers or purse seiners or capable of fishing by both methods, because trawling is commonly employed for surveying demersal resources even in areas where it is not the method preferred by the local commercial fleets; it is also often used in exploratory fishing on the bottom and in mid water over the continental shelves. Many fishery research vessels are fitted with elaborate "scientific" acoustic apparatus; only some are equipped for the stowage of substantial quantities of fish; comparatively few are equipped for work in the field of handling and processing and very few are fully instrumented for research and development on methods of capture.

3.6.2 Nevertheless there is a substantial degree of resemblance and, if the precepts of the preceding section (3.5 above) were always followed, the degree of resemblance would be even greater. It is therefore sometimes asked whether the costs of preparing a new design and specification and of building a single, custom-built ship might be avoided: why, it is asked, do fishery research vessels cost so much more than the nearest equivalent commercial fishing vessel and why cannot an existing design of a commercial vessel be adapted?

The designs of some of the most successful fishery research vessels are indeed based on existing successful commercial vessels. The design, however, usually has to be substantially modified in detail, particularly the steelwork, partly for the reasons connected with stability and trim given in 3.3.1 above; partly to accommodate "scientific" acoustic apparatus and partly to provide the additional accommodation for scientists, laboratories and other research-oriented work spaces.

It may be some years between the time a research organization acquires one research vessel and the time it acquires the next, so that it is to be expected that requirements will have changed and also the ideas on how best they can be met. This results in a succession of "one-off" designs. After all, the design of commercial fishing vessels is also in a continual state of change.

The additional costs of a research vessel, as compared with its commercial counterpart, lie partly in the special equipment and special features such as those mentioned in 3.7 below; partly in the fact that the designer and builder are unfamiliar with the detailed requirements; and partly in other reasons mentioned later below (4.2.6).

3.6.3 There is growing interest in the possibilities of the countries in a particular region, or bordering a particular area of ocean, sharing research vessels, and in the research vessels of the developed nations carrying out work for developing countries, as has already been done for example by FRIDTJOF NANSEN (Norway), WALTHER HERWIG (Federal Republic of Germany) and Japanese vessels. The experience with these vessel and those of the UNDP Research Vessel Pool operated by FAO shows that it is practicable to design and build fishery research vessels in such a way that they can be redeployed as circumstances require, in some cases being transferred half-way round the world, without having to incur excessive costs by way of modification for the new task. This again suggests that pleas and arguments for the design and construction of fishery research vessels with absolutely unique and very expensive features should be subject to very thorough and well-informed investigation before they are accepted.

The example of other research vessel pools, operating in the fields of oceanography and general marine science, is of particular interest in this respect. The vessels of the pool operated by the Natural Environment Research Council of the United Kingdom (an agency of government) can be employed by any of the constituent para-statal research organizations or associated university departments for a single voyage of a day or two, or for much longer periods, subject to demand and available finance. Thus each vessel may be used for research in many different fields in the course of a year or so: geology; planktonology; wave studies; to name a few examples. A similar approach is taken in France, where the Centre National pour l'Exploitation des Océans (CNEXO) operates a fleet of research vessels for various users. This may appear at first sight to give rise to problems in the design, equipment and operation of the vessels, and in the training of the officers and crews. However, when the tasks are examined from the points of view of the mariner, the naval architect and the engineer, the basic operations, equipment and techniques have much in common: the ship must have a capability for station-keeping and for very accurate navigation; it must be equipped to handle large, heavy and awkwardly-shaped objects over the side or stern and on the deck; it must be capable of operating towed bodies and other objects on the end of long cables; and it must have space and other facilities for storing samples and information, for processing information and for servicing instruments and electronic equipment. The purpose of the vessel is to provide a stable and dry working platform on which these things can be done, in the desired locations, and is not much affected by the particular field of science or research project that happens to be in hand, or by the particular techniques and instruments that happen to be in fashion.

3.6.4 It would be wrong to conclude from the foregoing that it is unnecessary to draw up a statement of operational requirements; or that in most instances one can proceed directly to the procurement of a research vessel of more or less "standard" type and of agreed size and power. This would pre-suppose that the procurement of a research vessel is justified, and that other solutions need not be examined. It also allows escalation of costs through overemphasis of particular features and equipment, and as a result of afterthoughts and new ideas in the course of design and construction. The statement of operational requirements, if drawn up with the assistance of experts with experience in the procurement and operation of research vessels, imposes a much-needed discipline on this situation.

Next to be discussed are special and unorthodox technical features, which are often to be found in research vessels, sometimes as the result of a genuine operational requirement, sometimes as the result of overenthusiasm coupled with inexperience.

3.7 Special and Unorthodox Features

3.7.1 Normally, the objectives of the designer of a fishery research vessel should be to provide a stable, dry working platform and a ship with good fishing performance, reliable, trouble-free and easy to maintain and service. As regards the design of the ship itself, and the selection and arrangement of machinery, these characteristics will be best assured by adopting accepted good design practice and by choosing makes and types of machinery and equipment, the operating characteristics and reliability of which have been well-proven in service in commercial fishing. Normally it should not be part of the designer's terms of reference to incorporate new or unorthodox ideas or unproven machinery and equipment; to do so is to invite trouble and run a grave risk of the vessel's availability for service being reduced and the costs of operation being increased.

Indeed, it is wise to choose, as far as possible, machinery and equipment, including electronic equipment, of types and makes used in the local fishing fleets or other locally-based vessels, so as to ensure that supplies of spares and the skills and experience necessary to ensure competent service and repair will be readily available.

3.7.2 There are occasional exceptions to this policy, but they must be based on clearly-stated and cogently-argued operational requirements.

Thus, the Torry Research Station in Aberdeen, when planning a new research vessel in the early 1950s, specified multi-engined diesel-electric propulsion, and this was the first British trawler to incorporate this type of machinery. At the time, the Torry Research Station was engaged in the development of systems of freezing at sea on board distant-water trawlers; the use of this form of propulsion was seen as solving certain problems and as being particularly suitable for freezer trawlers and factory trawlers. The decision to gain experience with a form of propulsion at that time unfamiliar to the commercial vessel operators was therefore part of a comprehensive development programme with clear objectives. Subsequently, commercial trawlers were built with this type of machinery; suitable alternative systems were, however, also developed and used.

3.7.3 The Research Vessel WALTHER HERWIG, as noted earlier, was specially designed to be used in programmes of trawl gear development. To this end, it was decided to instal very much greater propulsive power than in any existing commercial trawler, to ensure that the vessel would remain reasonably representative of the commercial fleet even if the trend towards ever-higher powers continued, and to enable her to handle any size of trawl likely to be used by the commercial fleet. (In the same way, the range of temperature of the cold stores at an establishment engaged in research on handling, processing and preservation, should extend down to temperatures lower than existing normal commercial practice, in order to provide more knowledge and experience and better understanding.)

3.7.4 Some fishery research vessels have been constructed in such a way as to produce very low acoustic signatures, i.e., the amount of noise, from machinery and other sources, transmitted into the water, is smaller than in the typical commercial fishing vessel, at least in certain frequency ranges: in these noise frequency ranges, such research vessels are unusually quiet, or at least that is the intention in their design. This is accomplished partly by having particularly large and slowly-turning propellers and partly by isolating the main sources of noise - engines, compressors and pumps - from the hull structure. The usual method of doing this is to mount all the machinery on a separate raft-like structure which in turn is supported in the ship by special elastic mountings, the stiffness and damping of which are so chosen as to prevent much of the noise and vibrational energy emanating from the machinery from being transmitted to the shell plating and thence to the water. This involves the driving of the propeller either through very expensive universal-jointed shafting or through an equally expensive electrical transmission.

The main object of these expensive and sometimes troublesome arrangements is to facilitate or improve the performance of certain types of investigation using underwater acoustic apparatus, either active or passive. One problem has been to specify what degree of noise reduction, in what frequency ranges, would be significant. Without a clear indication of cost-effectiveness, it is not justifiable to argue that the normal fishery research vessel should incorporate these rather expensive arrangements.

A similar cautious approach, with cost-effectiveness always in mind, should be adopted for other special, unorthodox arrangements and installations intended to facilitate particular types of study or the use of particular types of equipment, as, for example: very expensive special winches designed to handle the faired electrical cables which offer certain advantages when towing bodies carrying transducers (there may be other, less elegant but more straightforward solutions); means of handling submersibles.

In all these cases, the argument that some other research vessel incorporates such a feature, and that therefore no other research vessel can be completely up-to-date or fully effective unless it also incorporates the same features, should be resisted. Expensive and unorthodox features intended to facilitate research are often sources of trouble and should be justified strictly on their perceived merits in relation to the objectives and functions of the organization.

3.7.5 There is also the temptation to specify novel or unorthodox equipment and features for those areas of the ship that are not associated directly with research, often felt most strongly by enthusiastic but inexperienced research and development workers, who read of new ideas in fields of expertise other than their own - new systems of corrosion protection and anti-fouling; new methods of improving rudder performance or propulsive thrust; use of unorthodox grades or types of fuel; new types of anchor; to name a few possibilities at random. There may also be much enthusiasm for systems of waste heat recovery and other means of saving energy, often at higher costs than can be recovered over the lifetime of the system.

The correct answer to all such proposals is that, if the new method or equipment promises to be of interest to the commercial fishing fleets or to the world of shipping as a whole, it should be the subject of well-designed, properly organized and well-supervised trials in suitable conditions, as an approved part of a properly planned programme of technical development. A fishery research vessel is unlikely to provide the conditions in which the trial would be realistic or wholly convincing. Furthermore, the first priority must be so to design, build and operate the research vessel as to avoid prejudicing her effectiveness and reliability.

3.7.6 Within the user organization itself, new ideas or alleged improvements may have arisen out of the research and development programme and their originators and developers may strongly advocate their incorporation into the design and specification of the new vessel.

The approach should be the same as outlined immediately above: it is proper to use the research vessel as a vehicle for preliminary trials; quite another thing to use it as a means of demonstrating an untried idea. If the idea is not fully proven, an orthodox solution must be provided by the designer and shipbuilder for the user to fall back on; if the idea is already fully proven and accepted as good practice, there is no problem.

A similar situation can arise if, in the course of planning the new vessel, those whose responsibility it is to advise on the decision to build the vessel, consult other research organizations and departments of state, as for example, the research organization whose field is ship hydrodynamics and associated matters, or the military navy or the Ministry of Transport. In such cases, the approach should again be the same, but with the added precaution against incorporating features which, although proven in other maritime fields, have still to be shown to be relevant, appropriate and useful in the conditions of the fisheries industry.

On the other hand, proposals for the incorporation into the ship, at the time of building, of instruments and other facilities for the purpose of enabling research to be done in, say, for example, the field of ship hydrodynamics, are to be welcomed - provided, first, they do not prejudice the ship's capabilities as a fishery research vessel and, second, that satisfactory arrangements can be made for meeting the cost.

3.8 Inappropriate Features and Requirements

3.8.1 Sometimes a requirement is stated for a maximum free-running speed much higher than that of a corresponding commercial vessel. This may emanate from scientists or from fisheries administrators who are former or serving officers in the military navy. Such a requirement is dangerous because it will require drastic alterations in hull form and propeller characteristics, so that the ship may no longer perform well in the fishing role, nor will it be a stable and dry working platform in a seaway. It will also require large increases in power with concomitant additional costs.

3.8.2 Indeed it is unwise to specify a maximum free-running speed in calm water when procuring vessels of the trawler type. There will anyway be so much power installed for fishing that, when free-running, the vessel will be operating on a very steep part of the speed/power curve, so that the maximum speed is not easily predicted, but it will certainly be high for a vessel of that length and displacement. If the designer is required to guarantee a measured mile speed, he will do so by altering the hull form and propeller characteristics in ways prejudicial to the vessel's fishing performance and behaviour in a seaway.

In many cases, moreover, the vessel of typical trawler form will maintain higher passage speeds in wind and seas than a vessel of the same power and length with a higher maximum calm-water speed.

The research vessel should, nevertheless, be subjected to careful progressive speed trials on a recognised deep-water measured mile, if only to provide information for future design and to enable her to be operated with due regard to fuel economy. (In a typical trawler, reduction of power from maximum to three-quarters of full power will result in a reduction in free-running speed of less than ten per cent.)

3.8.3 Those with a background of the military or merchant navy are sometimes not sufficiently aware of the marked difference in numbers of officers and crew to be found in fishing vessels as compared with military and merchant ships. The appropriate standard for the fishery research vessel is the corresponding commercial fishing vessel; it has been remarked earlier above that space will be at a premium, besides which the requirements to carry out fishing operations speedily, efficiently and, above all, safely, mean that the numbers of people in the wheelhouse and on deck should be as few as can effectively do the job.

3.8.4 There is a common tendency to include in the operational requirements a request for accommodation for a greater number of research and development workers than is ever likely to be carried. Scientists whose fields of interest are such that they only occasionally have a need for work to be done at sea often exaggerate their requirements; there may also be a tendency to over-estimate the numbers of visiting workers and the frequency with which they will be present on board.

The types of work representing the biggest single demands on accommodation will probably be acoustic surveys conducted on a continuous, 24-hour basis and trawling surveys with sampling of catches for length, stomach contents, etc., also on a continuous 24-hour basis. Whether accommodation for research and development workers in excess of that needed for either of these tasks, is really required, is doubtful, and any stated requirements for more accommodation should be very carefully examined.

Even scientific and technical staff in technician and assistant grades who specialize as sea-going observers cannot be expected to average, over a period of years, much more than 100 days at sea in a year; if the ship spends 200 days at sea in a year, then there must be at least two people on the staff, able and willing to go to sea for 100 days a year each, to fill each scientist's berth on board.

Stated requirements for accommodation for 10 or even 12 more scientists and technologists should be examined on this basis - adjusting the figures for local conditions - and in the light of the known staff complement of the research establishment, or rather of that smaller number of people able, willing and available to go to sea.

3.8.5 Those responsible for advising on the decision to procure a new fishery research vessel sometimes refer the statement of operational requirements, or the draft specification, to other departments of government "for comment". Those who consult other departments in this way should be aware that such comment may be ill-informed or irrelevant. Few professionally qualified officials in other departments will be familiar with fishing vessels and fishing, and probably none with fishery research and development; there will be a tendency to quote the practice in the department asked to comment (for example the military navy may remark on the degree of compartmentation and mention that in all their vessels the electrical machinery is to special marine specifications and that all machinery is on shock-proof mountings); or else comment may be by way of quoting laws and regulations without reference to normal fishing industry practice: the department concerned with radio installations on ships for purposes of safety, for example, may quote the law, but the radio equipment of a deep-sea trawler (and of a fishery research vessel) will generally be far in excess of what the law requires as a minimum in a ship of that size, and indeed the electronics installation will be much more impressive than that formerly to be found in trans-Atlantic passenger liners.

That is to say, advice and comment from other departments can at times be misleading either by advocating unnecessary expenditure or by implying that less is needed than in fact is operationally justified and normal good practice.

4. PROCUREMENT

4.1 General Procedure

4.1.1 The procurement of a ship is a much less straightforward procedure, and much more complex and administratively untidy, than the procurement of, say, for example, agricultural tractors, aircraft or railway locomotives: these can be defined by make and model or type number, and there is limited scope for variations in the equipment that can be fitted. In contrast, terms such as "120-foot LOA 1200 s.h.p. purse seiner" are so vague and imprecise as to be almost valueless in defining what is required and how much it will cost. Constructing a ship is more like erecting an architect-designed building, or a large bridge, or building a big dam: ships, especially research vessels, are usually unique (even so-called sisterships often differ in detail); there is much scope for the exercise of individual style and the application of varying standards of quality; there is also much opportunity for changes of plan and a likelihood of unforeseen problems.

4.1.2 The stages in the procurement of a research vessel by a department of state, an agency of government, a university or other organization supported from public funds should be generally as follows:

(a) The justification of the proposed expenditure, the decision in principle to proceed and the preparation of a statement of operational requirements, all as discussed in 2 above, with preliminary rough estimates of cost.

(b) The allocation of funds.

(c) The preparation of a specification and outline general arrangement. This will be the basis on which tenders (bids) are invited for the construction of the vessel by shipbuilding yards, if this procedure is deemed necessary or desirable, or is required by financial rules governing procurement. In any case it will provide the basis on which to obtain better estimates of price, and part of the basis on which to negotiate the contract for building the ship.

(d) Amendment of the specification and general arrangement in the light of discussions with the chosen contractor.

(e) Negotiation of terms of contract. Placing of contract.

(f) Supervision of construction. Discussion of proposed amendments to contract or specification; negotiation thereof.

(g) Training of officers and scientists in use of new equipment.

(h) Supervision of builders' trials; conduct of owner's trials; registration, acceptance and delivery.

(i) Invoking guarantees as may be necessary; final adjustment of price.

4.1.3 The procedure outlined above is not as simple and free of potential difficulties as it may appear to the layman. Various misunderstandings and misconceptions can arise, largely as a result of lack of experience, that may result in heavy additional costs, delay in delivery and even in a vessel less effective than it should be, as for example:

(i) The estimates of price received from builders may be so much higher than expected that application has to be made for allocation of additional funds, or else the specification has to be amended so as to reduce the cost, and perhaps some of the operational requirements modified or dropped.

(ii) Provision has to be made in the contract, and in the allocation of funds, for contingencies and especially for amendments, modifications and additions to the specification. At the same time, in order to avoid delays in construction and large increases in prices, authority and responsibility must be allocated, and procedures adopted, so as to keep the tendency to order alterations and additions under control.

(iii) Contracts for the building of ships must have regard to the imperatives of ship construction; standard government purchasing contracts may not be appropriate and reliable well-informed professional advice and supervision are required.

(iv) Vessel design and construction; the art and practice of fishing and the choice of equipment; the methods and equipment of fisheries science and technology; standards of construction and safety; are four largely separate and distinct areas of expertise. Arrangements must be made to ensure that competent advice and supervision is available in all four areas and that the shipbuilder is effectively supervised in all four areas. A clear statement of where authority and responsibility lie is necessary, and appropriate procedures must be followed.

(v) Finally, whatever supervision is exercised by maritime safety authorities and classification societies regarding standards of construction, the quality of workmanship and materials will depend to a large extent on the owner's wishes and on the standards set and the vigilance exercised by the owner's representatives at the shipyard and at sub-contractors' works. The ease and convenience of operation and maintenance of machines and other items depends a great deal on a similar exercise of vigilance during fitting-out.

4.1.4 The purchaser of a fishery research vessel needs professional advice and assistance in both the technical and the contractual aspects of the design, construction and procurement of ships.

He is unlikely to possess the necessary knowledge and experience himself, because such a long time will usually have passed between the procurement of one research vessel and the decision to procure the next, that there will have been changes in the staff of the administrative and financial branches and perhaps also among the senior scientists and technologists; there may well also have been changes in procedure.

4.2 Some Administrative and Financial Points

4.2.1 A ship of any great complexity and substantial size will take many months to design and construct even if a building berth is immediately available and there are no delays in the delivery to the shipyard of materials, components, machinery and equipment. The likelihood is that the process of procurement, from the time that authorisation is given to commit funds, to the paying of the final outstanding sums due to or from the builder at the end of the guarantee period, will extend over three or more financial years.

Some governments operate systems of accounting on a purely cash basis with provision of funds in such a way that any sums not expended by departments by the end of the financial year revert to the central treasury and have to be re-voted or re-authorized for the following financial year. Such rules are sometimes operated fairly rigorously by the kind of departments likely to be concerned with the acquisition of fishery research vessels, and if invoked pedantically may well result in problems and delays in the procurement of research vessels. Departments concerned with defence or with large public works, on the other hand, are familiar with the problem, and will have adopted procedures that allow commitment of the entire sum required and carry-over of the outstanding balance from one financial year to the next. Where there is capital accounting as well as cash accounting the problem may not arise in such an acute form.

4.2.2 Shipyards require payment of part of the contract price at stages in design and construction defined in the contract, partly in order to enable them, in turn, to pay for supplies of materials and for equipment made by sub-contractors; partly to reduce their financial risk.

The amounts and timing of the stage payments cannot be forecast precisely. The system of authorizing and making payments by the purchaser must be sufficiently flexible and rapid to relieve the shipbuilder of any possibility of financial embarrassment, or else he will invoke penalty clauses in the contract; he may suspend the issue of further orders for materials, components, etc., and stop further work on the ship. This always leads to additional expense.

The question of whether the stage of construction has been reached when a further instalment of the contract price should be paid (or a proportion thereof, by agreement) is a matter of technical judgment on which the purchaser will require advice and assistance.

4.2.3 A contract for construction of a ship, acceptable to a shipbuilder, will include provision for termination of the contract only at certain stages of construction and will provide that, if the order for the vessel is cancelled during construction, the shipbuilder can carry out certain work thereafter at the expense of the purchaser in order to make it possible to remove the partly-constructed vessel from his building berth or fitting-out basin: either by dismantling or by completion to a stage when the vessel can be (launched and) towed away. That is to say, the purchaser cannot cancel the order whenever he likes, without incurring the obligation to make extra payment, but only at certain previously-agreed and customary stages of construction.

A similar philosophy may be applied in certain cases regarding "extras" - additions or alterations to the specifications. The builder may charge as if for completing the ship to the original specification, then dismantling and removing of parts no longer required, and for any alterations to the structure that would then be necessary, in addition to charging for supply and fitting of items according to the amended specification.

4.2.4 "Extras" can be a prime cause of the final price exceeding the contract price by a very substantial amount: even in the case of commercial fishing vessels, two trawlers to the same design, built by the same shipyard for two different owners, have been known to differ in final price by as much as thirty per cent. One owner orders no "extras"; the other keeps having new ideas. Research and development workers are particularly prone to this habit.

Its effects can be reduced and curbed if the original statement of operational requirements is carefully drawn up by an expert with previous experience of procuring and operating research vessels - which will have induced in him a useful degree of scepticism regarding afterthoughts - and if the original specification is thoroughly examined and discussed by the designer with the users and with the assistance of the same expert. Any new idea put forward subsequent to the signing of the contract with the shipbuilder should be subject to thorough scientific, technical, financial and administrative investigation at senior level, with a requirement to consider whether, even if it is accepted as necessary or desirable, it may not be cheaper and better to postpone the alteration or addition until after the completion and delivery of the ship and to make it the subject of a new contract.

Only one official, or two or more officials acting in concert, should have the powers to authorize amendments to the specification, and they should be designated in the building contract. One of the officials should be the scientist or technologist responsible for the fisheries research and development programme; the others should be the senior professional marine engineer superintendent, if any, in the organization, and a senior finance official or administrator.

4.2.5 The propensity to purchase scientific equipment by including it in the specification of the ship should be resisted, except in those cases where it has to be built into, and becomes part of, the ship.

4.2.6 Even with all these precautions, the cost of a fishery research vessel can be much higher than that of the corresponding commercial fishing vessel with the same basic hull and machinery, sometimes twice as much. There are several reasons for this.

First, there is the genuine, visible additional equipment: "scientific" acoustic apparatus; oceanographic winches; laboratories; accommodation for scientists; various technical additions to achieve space-saving as suggested in 3.3.2 above.

Second, the shipbuilder may be unfamiliar with those items of the specification arising from the research and development requirements and which differentiate the fishery research vessel from the commercial fishing vessel; he will in consequence be cautious in making up his estimates of price.

Third, there are the "extras", discussed in 4.2.4 above; shipbuilders tend to encourage owners to indulge in "extras" for obvious reasons.

Fourth, in some countries, government orders are regarded as a legitimate opportunity to recoup losses on previous orders or as a source of virtual subsidies to allow especially keen prices to be quoted for commercial vessels.

Fifth, the design and equipment of the ship may have to be more costly than those of the corresponding fishing vessel, for legal reasons mentioned later below.

4.2.7 It should not be supposed that shipbuilders are accustomed to, or in favour of, competitive tendering. Although there may be more competition nowadays than a generation ago, many owners prefer a particular shipyard, or select their shipyard primarily on grounds other than price, and only subsequently negotiate the price. Even governments, through their defence departments, place orders with shipyards with regard to considerations other than that of price.

4.2.8 Nevertheless, or perhaps as a consequence, almost all shipowners tend to prefer specifications that result in comparatively low capital costs, at the expense of incurring high costs of operation or maintenance. Owners should at least be aware of this tendency, and ask themselves whether the policy it represents is the correct one for their own particular circumstances.

4.2.9 The price that a particular shipyard will quote against a specification is governed by a number of factors, some of them imponderables. The cost of construction - and for that matter the finished cost, in all but the most sophisticated yards - is not built up detail by detail from known or predicted quantities and prices of materials, labour, components and bought-in equipment, but estimated by rule of thumb and from experience. The tender price will depend upon such matters as the length of the order-book, the shipbuilder's forecast of trends in economic circumstances and in the prices of such items as are not covered by escalation clauses; on his expectations regarding the amount of "extras"; on his apprehensions at dealing with strange, scientific customers requiring unusual things; on his expectation or otherwise of ever receiving another order from the same or similar sources; and on the attitude to government orders as already discussed.

4.2.10 Fixed price contracts, in times of inflation and rising real costs, will carry heavy penalties by way of hedges against delays and against unexpectedly high rises in prices of bought-in items and labour. Defence departments tend to place shipbuilding contracts that are nearer to the cost-plus-agreed-profit formula, and using them as agents may be costly. The purchaser needs guidance and advice on the type of contract he should negotiate with the builder, but he will probably have to seek this advice outside the government machine if he is to get the best terms.

4.2.11 For all these reasons, as well as those adduced earlier and others put forward in 4.3 below, the purchaser of a fishery research vessel needs the advice and assistance of an individual or an organization knowledgeable and experienced in the negotiation and supervision of contracts for the construction of ships of the fishing vessel type, in shipyards specializing in such work. It is unlikely that such expertise is available within government, except in those cases where there is a large state fisheries corporation with its own professionally qualified staff of naval architects and marine engineers. In the most usual case, it will be best to engage the advice of a firm of consulting naval architects possessing the appropriate knowledge and experience as indicated in 3.2 above.

The channels of communication between the purchasing organization, the consultants or advisers and the shipbuilder, must be clearly defined. If anybody and everybody with an interest in the new vessel is allowed to communicate directly with the shipbuilder, the positions of the consultants or advisers and builders become impossible, and financial and contractual chaos is likely to ensue. Therefore:

(i) The purchasing organization must designate in the contract an individual official or group of officials, as already suggested in 4.2.4 above, to be the sole representative of the organization in all negotiations and communications with the shipbuilder; these communications should in all cases be conducted through, and discussions and negotiations conducted in the presence of, an accredited representative of the consultants or advisers. All discussions and negotiations should be recorded in writing by the shipbuilder and the record approved and signed or amended as may be by the consultants, after consulting the owner's representatives.

(ii) The owner's representatives should be allowed financial authority as regards travel in order to avoid delays in consultation, and should be given provisional authority to settle, on the advice of the consultants, any problems arising in the course of procurement of the ship that would, if not settled immediately, result in costly delays. Approval for such decisions should be sought in retrospect, and supported by a report from the consultants.

(iii) The consultants should instruct the shipbuilder directly on purely technical matters of ship construction that do not affect the operational requirements. On matters that do affect the operational requirements, they should consult and seek the approval in writing of the owner's representatives before instructing the shipbuilder.

(iv) Similar procedures should be adopted in transactions with maritime safety authorities and classification societies.

4.2.12 If the purchaser of the vessel is in a developing country where facilities for drydocking and major repairs are inadequate, care must be taken to ensure that the builder has included in his tender price a contingency amount for taking the vessel to an agreed shipyard or ship repair yard if this turns out to be necessary under the guarantee clause.

4.3 Technical Advice and Assistance

4.3.1 A research and development organization procuring a new fishery research vessel will normally need technical assistance in the following:

(i) Preparation of the statement of operational requirements (see 2.3.2 above).

The only exception is where the staff of the organization itself includes not only experienced senior scientists but also an experienced professionally-qualified marine engineer superintendent. Such a man would hold an internationally-recognized certificate of competence as a Chief Engineer in the merchant navy, with several years of experience as a sea-going engineer officer and some years of experience in the supervision of the maintenance, repair and servicing of fishing or fishery research vessels. It is not at all adequate to substitute for such a man, as is sometimes done, a young graduate in engineering with little or no industrial or sea-going experience.

(ii) Preparation of the draft specification and provisional general arrangement drawing (and see 3.2.1 above).

This is the province of professional naval architects and marine engineers specialising in the design of fishing vessels. It is rare to find such people within the public service, unless there is a large state fisheries corporation which possesses the capability for designing its own vessels. There may be professional naval architects and marine engineers in other departments, but their experience of design will be either very limited or largely irrelevant, and they will know little or nothing about fishing vessels. It will normally be necessary to engage independent consultants.

(iii) Discussing with the shipbuilder's design department and drawing office the detailed specification; approving the specification, the lines plan, the calculations of displacement, stability and trim, and the detailed construction drawings; interpreting the owners' requirements to the builder; advising the owner on proposed modifications and alterations; negotiating with classification societies and maritime safety authorities on technical matters; supervising tank tests of ship models; supervising construction of vessel and machinery, supervising acceptance trials; advising on techno-legal aspects of procurement.

If the purchasing organization already possesses on its staff a professionally-qualified marine engineer superintendent as defined in (i) above, and if the new vessel is fairly small and simple and is being built near to his usual base of operations, it would be in theory possible for much of this work to be done by him. However, marine engineer superintendents are usually very busy men, concerned with keeping the vessels of the existing fleet at sea; in a case where the new vessel is of any size, he would anyhow need help in carrying out the above tasks.

The same remarks therefore apply as in (ii) above: the advice and assistance of independent consultants with the qualifications specified in 3.2.1 earlier above will normally be required. They will probably be required in any event for the contractual and financial aspects of procurement, as already explained in 4.2.11.

(iv) Specialized advice in the fields of fishing technology and scientific equipment (see 3.2.3 and 3.2.4 above).

4.3.2 It is a mistake to suppose that if the vessel is built to the Rules of an internationally-recognized classification society and under the supervision of the society's surveyors, that the owners' interests will be completely covered. Classification societies are concerned mainly with matters related to insurance, that is to say, with the safety and seaworthiness of the ship and with the reliability of the machinery, insofar as it affects safety, seaworthiness and other risks. They are not at all concerned with operational effectiveness. Thus, their interest, as classification societies, in such items as fishing winches, electronic and acoustic apparatus, and laboratories, is confined to the potential risk they constitute to safety.

Moreover, even as regards standards of construction and safety, classification societies vary, as do their local surveyors in their interpretations of the rules. As mentioned earlier, quality of materials and finish can vary widely, and so can operational convenience in layout of pipework, valves, deck equipment and so on.

The owners' interests must therefore be looked after by their own representatives, i.e. either by their own professional staff or by independent consultants.

4.3.3 What has just been said about the role of classification societies generally applies equally to that of the government's own maritime safety authority. However, they should be actively involved at the stage of design and construction, even if, or especially if, the vessel is built abroad, to ensure that their approval is forthcoming.

4.3.4 Some classification societies do provide consultancy services to look after owners' interests in addition to their own. Few of these, however, will be able to claim long experience of fishing vessel design and construction.

4.4 Secondhand Vessels

4.4.1 It is sometimes suggested that it should be cheaper and quicker to purchase and convert an existing ship than to design and build a research vessel from scratch. Some large ocean-going fishery research vessels commissioned in recent years began life as commercial fishing vessels, as for example the Moroccan R/V IBN SINA.

4.4.2 The organization that is to operate the vessel is usually reluctant to accept this solution, the research and development workers being afraid that the operational requirements will not be met as fully as they would be by a specially-designed custom-built vessel. From what has been said earlier above, these fears may well be exaggerated. The really valid objections to the conversion of secondhand vessels into research vessels are of a different kind. They relate to the assumptions that the resulting vessel will be cheaper and will be available sooner. Generally speaking, such assumptions are not well founded.

As indicated in 3.6.2 above, there will probably have to be some modification to the steelwork to accommodate the scientific requirements, and additions to the superstructure, besides alterations to the ship's services. Generally speaking, the conversion of a ship for a new task can take nearly as long as building a new one. It can also cost as much.

4.4.3 The proposal to provide sea-going research facilities by the purchase of a secondhand vessel is therefore only likely to be satisfactory in two kinds of circumstances:

(a) if an existing fishery research vessel which meets the operational requirements comes on the market. This would not have been very likely in former times, but a growing number of the larger research vessels is laid up because of their high costs of operation.

(b) if the operational requirements are such that they can be satisfied by minor modifications to a commercial fishing vessel.

4.5 Other Incidental Costs

4.5.1 The need for technical assistance in the procurement of fishery research vessels is only one of the sources of additional costs, over and above the purchase price of the vessel itself. Others that are often overlooked are the need for training and for travel of scientific, technical and professional staff in connection with procurement and in order to ensure operational effectiveness.

4.5.2 The designated Chief Engineer of the new vessel should be present in the manufacturers' works when the main and auxiliary engines are being assembled and bench tested. He or his second engineer should likewise attend the works of the manufacturers of fishing winches, hydraulics systems and refrigerating machinery at similar stages in the construction of such items. They should thereafter stand by in the shipyard during the installation of the machinery, pipework, electrical wiring, etc., and during all tests and trials; they should take part in the delivery voyage.

The master of the vessel, his first officer and the radio officer, if one is appointed, should spend short periods as may be agreed at the works of the manufacturers of navigational equipment and fishing aids, and of the oceanographic winches if fitted. Thereafter they should stand by at the fitting-out, trials and delivery voyage of the ship.

4.5.3 The senior resources biologist concerned with stock assessment and his acoustics expert may need to travel to other fishery research organizations and to manufacturers' works in order that they can make informed decisions about the make and type of "scientific" acoustic apparatus to be fitted. A senior scientist must do the same in respect of other major equipment (for example, oceanographic winches) and laboratory equipment, advise on laboratory layout, and stand by while the laboratories are being fitted out. If possible, the consultant naval architects should accompany the scientists on their visits to other user establishments.

The acoustic expert should undergo a course of training at the works of the manufacturer of the "scientific" acoustic equipment and subsequently stand by during its installation on board.

4.5.4 The need for the services of an experienced fishing technologist or masterfisherman, to advise on the detailed specification and placing of fishing deck equipment, has already been mentioned, as has the involvement of the national marine authority (4.3.3).

4.6 Owner's Supply Items

4.6.1 It is customary for some items to be supplied by the owner: for example, fishing gear such as nets, otter boards, hooks and lines; measuring apparatus; scientific equipment not permanently fixed to the ship. Other items that may or may not be owner's supply include, for example, sets of navigational charts; bedding; cutlery and crockery; cooking utensils; life-saving apparatus.

4.6.2 Other items that may be owner's supply include navigational equipment, radio, echo-sounders, computers, etc. Manufacturers of some types of navigational aids insist on outright sale; others will only lease or hire the equipment; others may be willing to do either. A lease or hire agreement will include a contract to service and maintain the equipment.

4.7 Additional Spares

In certain circumstances (see 9.4 below) it may be desirable for the ship to be delivered complete with a very ample stock of spare parts, components and materials to be used for routine maintenance and repair. It is not practicable to prepare a list of what may be required until the ship is in course of being built; this stock of spares will therefore constitute an "extra".

5. OWNERSHIP; SPECIAL RESPONSIBILITIES AND LIABILITIES

5.1 Legal Ownership

5.1.1 For reasons that will become apparent later below, it is important that the ownership of a sea-going vessel supported by public funds should be vested in a clearly-identified legal person or legal entity: an individual citizen or a corporation or other organization possessing a legal personality.

It may not be sufficient to assume that because "the government" has paid for the vessel and meets her operating costs, that all is well in this respect; the situation may differ according to the laws, the legal traditions and the form of government of the country of registration.

5.1.2 For example, unless the ownership is clearly defined as just suggested, it may be held that it is vested in the Head of State; in some countries, the Head of State may be immune from certain kinds of legal proceedings in the courts of the country. This could raise difficulties for officers and crew, research and development workers who sail in the vessel, contractors and third parties.

5.1.3 In some countries at least, universities, government agencies and even departments of state may need enabling legislation to permit them to own and operate ships. In one case where a department of state was not positively authorized to own ships, the ownership had to be vested in the current Director of the research establishment operating the vessel; his successor "bought" the vessel from him for one shilling, and in turn became the registered owner, and so on. This may appear at first sight a harmless idiosyncrasy, but a little thought will show that the responsibilities and liabilities stemming from the ownership of even a small sea-going ship are such that the arrangement is basically unsatisfactory and fraught with unpleasant legalistic possibilities, unless the personal position of the individual acting ex-officio as registered owner is very well safeguarded, and unless the government unhesitatingly accepts the normal liabilities and responsibilities of a shipowner.

5.2 Special Responsibilities of Owners

5.2.1 Little need be said about the responsibilities of the owners of fishery research vessels towards their officers and crews, research and development workers and other employees, and others who may come on board, or towards those in contractual relationships with them of one kind or another.

5.2.2 In at least some countries, however, the laws relating to shipping contain, or have in the past contained, a clause or clauses exempting the government itself from compliance with these very same laws, and any associated laws relating to maritime safety. The intention, presumably, is to protect the military navy, the rescue services and similar organizations from having to comply with inappropriate or irrelevant regulations.

Since, however, fishery research vessels resemble commercial fishing vessels very closely and may often work alongside them, it is usually thought to be the best policy in this case for the government to show a good example to the owners of commercial fishing vessels; this it can do by being seen to comply fully with all its own regulations and with international recommendations about standards of construction, safety of life at sea, manning scales, qualifications of officers, etc., even if, in law, it has in theory given itself exemption from such regulations.

5.3 Special Liabilities and Risks

5.3.1 Always in the thoughts of good shipowners, professional fleet managers and their engineer superintendents, are the subjects of safety at sea and marine risks. Individuals embarked on the ship can be injured or lost overboard; the ship itself may be involved in collision, or stranding; it may go on fire or sink; it may suffer breakdown or loss of steerage, and have to accept a tow. Such accidents can result in loss of life or limb of individuals not in the employ of the owner, as well as to his employees; or in loss of or damage to property, other than the owner's, as well as to the ship. If the accident happens on the high seas - and even perhaps if it does not - and foreign nationals or ships under a foreign flag are involved, the owner may be sued in foreign courts as well as in the courts of his own country. It will be particularly embarrassing for a government to be so sued, especially if there is evidence of poor or slack management.

Fishery research vessels, in both developed and developing countries, quite frequently carry visiting experts, often foreign nationals. At times they may work in shipping lanes where comparatively small, slow-moving vessels are not normally to be encountered, or off hazardous coasts, and in rough weather and poor visibility.

The owners and managers of fishery research vessels are not always good owners and managers in the sense under discussion. Being for the most part laymen in these matters, they often lack the almost instinctive feeling and concern of professional shipowners and fleet managers for safety at sea and maritime risks. To give only one example, they sometimes do not even have in being a rigorous system whereby the ship reports daily or twice daily, by radio, her position and state of serviceability and integrity.

5.3.2 The master of a ship, unlike the captain of an aircraft, does not have to file a flight plan before departure, or obey any traffic controller, except in certain very limited sea areas: once he leaves harbour, he is normally in complete control and can go where he pleases, within the capabilities of his vessel. Ships can be blown off course; navigational errors can be made even in these days of electronic aids. Fishermen are especially prone to entering waters under the jurisdiction of, or claimed by, countries other than their own. The international incidents so created are all the more reprehensible if the offender - innocent or otherwise - is a government-owned fishery research vessel.

It has been known for a fisheries survey to be arranged in which a research vessel from a developed country was chartered to carry out work within the Exclusive Economic Zone of a developing country - for the benefit of that country, among others. The organizers of the survey instructed the chartered vessel to start work without either they or the owners first checking that the naval authorities of the coastal state had been informed of the arrangement; the research vessel was arrested, to the considerable embarrassment of all concerned, and with consequent expense and loss of working time. The incident could well have led to the cancelling of the survey.

The owners and managers of fishery research vessels have to bear in mind the possibility of incidents of this sort and especially to ensure as far as possible that what may appear as provocation is not inadvertently offered to the authorities of other coastal states by careless seamanship and navigation or by over-enthusiasm on the part of scientists.

Where the vessel is in foreign waters by agreement, the good owner and fleet manager will take particular care to ensure that the agreement is well-publicised, that all concerned are informed, that the necessary courtesy flags are flown, and that observers from the coastal state are embarked. This is especially necessary if the work is being carried out in a chartered commercial fishing vessel; indeed, one of the arguments for governments owning fishery research vessels is that they may be allowed to go where, politically, it may be unwise to venture in a chartered commercial vessel because of local antagonisms.

5.3.3 Behaviour of officers, crew and scientists in foreign ports is another possible cause of relations becoming less amicable and cooperative than the director of research and the authorities would desire. The good owner and fleet manager will ensure that adequate briefing is given on this point and good discipline maintained.

They also run the opposite risk: the officers and scientists in some fishery research vessels have been known to develop the habit of frequently spending a few days in a friendly foreign port, on the pretexts of bad weather, need of minor repairs, or shortages of food, water or stores. Such behaviour can bring the fisheries research and development service into disrepute both in the foreign country and in the fishing fleets it is supposed to serve.

Discipline is discussed below (11.4), as is the other topic touched upon earlier above: safety.

6. SAFETY

6.1 General Considerations

6.1.1 This document does not pretend to be a manual on the day-to-day detailed management and operation of fishery research vessels, only a compilation of some of the principles that should govern such activities, with illustrative examples. Safety, in any case, is at least as much a matter of attitudes as of rules, equipment and routine.

6.1.2 As already remarked, some fishery research vessels are designed, constructed, maintained and operated in such a way that it is hard to escape the conclusion that the owners and management are not as safety-conscious as good shipowners and fleet managers should be.

Besides failing to show a good example, as governments should, this is bad economics. The research and development workers on board the vessel will be difficult to replace if incapacitated or killed; the officers and crew also will have developed special skills. Any interruption to the research and development programme is, presumably, a serious blow to the future well-being of the fishery; the research vessel itself will be difficult to replace quickly. Even if there are no serious accidents, morale will not be as high as it could be and productivity will be lower.

Bad maintenance and slackness with regard to safety may lead to difficulties in settling insurance claims, if the vessel is insured. There is also the danger, remarked above, of serious embarrassment to the public service and government, nationally and internationally.

6.2 Standards of Construction and Maintenance

6.2.1 The primary method of ensuring the safety of the ship and those on board is to construct her to reasonably high standards and to maintain her in that condition. More will be said about maintenance later below.

6.2.2 The standards of construction should be those laid down by one of the internationally recognized ship classification societies in their rules for classification of fishing vessels of the appropriate type, if such rules exist, but should comply instead with the rules laid down for such vessels by the national maritime safety authority, in cases where these are more stringent.

For types of vessel for which the classification societies do not have rules, guidance may be obtained in some cases from standards laid down by government agencies as, for example, those laid down by the former White Fish Authority in the United Kingdom, for wooden vessels intended for rough-water operation in the open sea in cool temperate latitudes. Insurers, and especially fishermen's mutual vessel insurance societies, may also have useful information and advice.

6.2.3 In all cases, due regard should be had to the recommendations and requirements of the International Maritime Organization (IMO) as laid down for example in the Torremolinos International Convention for the Safety of Fishing Vessels, 1977 (but as regards transverse stability, see below).

6.2.4 The organization should have on its staff a professionnally-qualified marine engineer superintendent responsible for the maintenance of the research vessels (irrespective of whether the actual work of maintenance is done in-house or by some external agency). If this man is professionally qualified, with some years of experience as a sea-going engineer officer in merchant ships and some years of experience of fishing vessel maintenance, and if he is given sufficient authority and financial resources, this will be one of the best ways of ensuring that the ship is basically safe and reliable. Such a policy is also sound economics in terms of vessel life, vessel availability (readiness-for-sea) and vessel utilization, as discussed later below (Chapters 8 and 9).

6.2.5 Where the vessel type is one for which the Rules of a classification society are appropriate, the vessel may be "built to class" but not "classed", or else she may be "classed" and maintained "in class"; in the latter case she will be subject to regular survey by the classification society. For fishery research vessels, which are usually operated by organizations not primarily consisting of professional shipowners and managers, where the objectives are not primarily the successful operation of ships, and who depend upon a single marine engineer superintendent, it will be wisest and safest to maintain the vessel "in class", as an assurance and demonstration that certain recognized standards are being upheld.

6.3 Transverse Stability

6.3.1 The International Maritime Organization (IMO) lays down minimum requirements for transverse stability of fishing vessels. Care should be taken that the designer regards these as minima, and not necessarily as adequate, let alone stringent. There is a strong and growing body of opinion, supported by evidence, that for fishing vessels in rough seas in temperate and high latitudes, the IMO requirements are not stringent enough: see, for example, various papers, contributions to discussions and correspondence in the Journal of the Royal Institution of Naval Architects during the years 1980 to 1982.

6.3.2 The designer must bear in mind the effects of any additional superstructure - especially on windage and ice accretion - as compared with the average commercial fishing vessel.

He must also bear in mind the greater possibility of the vessel returning to port with no catch and most of the fuel and water consumed. If facilities are provided for taking on seawater ballast, due regard should be had to the caution in 3.3.1 above.

6.4 Special Risks

6.4.1 Special risks arise from the presence on board of research and development workers; the carrying of solvents, reagents, corrosive fluids, bottled gases, mercury and so on; and the installation and use of laboratory equipment, experimental apparatus and pilot plant.

6.4.2 (i) Drains from laboratory sinks and the like should be so arranged and connected that there is no possibility of the ship's pumping systems being put out of service by corrosive or volatile liquids, mercury, solvents, etc. This is best accomplished by providing a dump tank, constructed in suitable corrosion-resistant material, well-ventilated to a high point on the mast, with its own "chemical" pump, standby pump and corrosion-resistant piping to discharge laboratory waste overboard.

(ii) The electrical supplies to the laboratory spaces should be electrically and physically isolated from the ship's electrical system, so that there is no possibility of a malfunction in the laboratory causing a blackout of the ship. This is best done by means of a motor alternator - not by a rotary converter or static converter or transformer, none of which provide sufficient physical separation of the two sets of circuits.

(iii) The laboratory and pilot-plant spaces should be force-ventilated, the outlets being at a high point on the mast.

(iv) All novel apparatus and locally-built experimental equipment brought on board should be approved by the marine engineer superintendent in respect of safety; the design, construction and installation of pilot plant should also be approved by him as regards safety.

(v) The procedures adopted in investigations involving the use of noxious substances, and the manner of operation of experimental apparatus and pilot plant, should be approved by the master of the vessel advised by the marine engineer superintendent. The Master is legally responsible for the safety of the ship and those on board.

(vi) Care should be taken in the handling and storage of noxious substances, especially those resembling foodstuffs or beverages (for example, sodium nitrite): whereas the scientists may be confident in their handling of such substances, it is possible for mistakes to be made by the crew.

6.4.3 In addition to normal boat and fire drills, those research and development workers who are at sea for the first time or who go only occasionally should be briefed and trained as necessary in how to move about the ship in heavy weather; how to cross an open deck when the ship is taking water; and what to do when a man goes overboard; they should be warned not to wander about alone on unfrequented parts of the weather decks especially during hours of darkness.

6.4.4 The Master of the vessel should have the absolute right to refuse to embark any research or development worker who, in his opinion, may endanger himself, his shipmates or the ship; the Master should have powers to restrain any such person on board.

6.5 Safety Equipment and Procedures

6.5.1 Little need be said about safety equipment such as life boats, life rafts, life jackets, portable fire pumps and the like, except that the scale of provision and quality of equipment on a fishery research vessel should be high, and should comply with all relevant regulations. The equipment must be maintained in a fully-serviceable condition and frequent checks made that the correct quantities are on board.

One of the most common and obvious indications that the owners and managers of fishery research vessels are not always as conscious of safety as they should be, is deficiencies in the safety equipment on board.

6.5.2 The Master is responsible for seeing that frequent boat drills and fire drills are carried out and for instituting fire patrols at night when on passage. The discharge of the Master's responsibilities in these respects may at first sight seem to be a matter of qualifications, training and discipline on the part of the Master, his officers and crew; it also requires, however, good morale, which will come from the conviction that the owners and fleet manager are genuinely interested in safety. This conviction will be fostered by, among other things, providing adequate financial and other resources for maintaining the safety equipment.

6.5.3 In many parts of the world there are more accidents to fishing boats from stranding and collision than from bad weather. Avoidance of collision and stranding is a matter of good seamanship: maintaining a proper look-out at all times; restricting speed when necessary; proper use of navigation lights, fog signals and signals indicating the ship is not fully under command (fishing, using oceanographic winches); proper use of radar; proper attention to weather information; accurate navigation.

These things are more difficult for the Masters of fishing vessels and research vessels than for their colleagues in military, merchant or passenger ships, because there are very many other things to attend to when the ship is actually fishing or otherwise working, and fewer officers to help. In some parts of the world, fishermen place too much faith in automatic pilots, especially when returning to port after an arduous time on the fishing grounds.

Insofar as the research vessel may be working amongst fishing vessels, and following the same courses to and from the fishing grounds and home port, and insofar as her officers and crew share the same background and attitudes as the commercial fishermen, the fishery research vessel may be nearly as much at risk from collision or stranding as her commercial counterpart. Again, the main factors in avoiding accidents will be qualifications, training, experience, discipline and morale; the last will be fostered by good management including good maintenance.

6.6 Daily Reporting

6.6.1 Every fishing vessel on a voyage of more than 24 hours' duration should, if equipped with a radio transmitter and receiver, report at least daily to the owner as a routine safety precaution. If necessary, the message should be relayed by another ship or shore station.

The message should indicate position, weather, state of fuel and water reserves, a report on the integrity and operational serviceability of the vessel, any injuries or sickness, and so on. It may be combined with messages on operational matters such as amount of fish caught, intended day of arrival in port, need for repairs, stores, etc., on arrival, and so on.

The owners should designate officials whose duties are to receive such messages and to take the necessary action when a ship fails to report. A duty roster for these officials should be prepared by the fleet manager.

The action to be taken by the official on duty, if a ship fails to report, should be laid down in writing. Generally speaking, it should take the form of warning the management and activating a look-out by other vessels and a radio watch; if the ship still fails to report by some stated time, the search-and-rescue services should be informed and other vessels asked to conduct a search.

6.6.2 Such a system of daily reporting, and the same procedures in case the ship fails to report, should be operated by the owners and managers of fishery research vessels, which should be equipped with radio telephone and radio telegraphy facilities.

7. COSTS OF OPERATION

7.1 Operating Costs of Fishery Research Vessels

7.1.1 The costs of operating fishery research vessels usually represent a very substantial proportion of the total sums allocated for fishery research even including any sums voted for technical development. They are so high, indeed, that they often prompt the question of whether the money could be better spent and whether there are other means by which the required information can be produced.

7.1.2 The UNDP Fisheries Research Vessel Pool has been in existence for a number of years; it comprises ships of various sizes up to 47 m LOA and 1300 Shp., working in most parts of the developing world. Through the management of the Research Vessel Pool and of other research vessels, and in other ways, including charters, the Department of Fisheries of FAO has gathered a great deal of information on the costs of operation of fishery research vessels. They vary, as might be expected, according to the sophistication of the vessel, the standards of living and wages of local crew, other local costs, the local price of imported spares and stores, the availability or otherwise of local facilities for repair, maintenance and survey.

Costs of maintenance and survey vary from year to year depending upon what kinds of system of major overhaul and inspection of machinery is adopted and because the normal cycle of overhaul for a ship lasts four years. The figures about to be quoted are averages, that is to say, the sum expended over four years would be four times the annual sum quoted, but the actual expenditure could vary from year to year during the four-year cycle.

Annual operating costs of fishery research vessels average between 35 per cent and 55 per cent of the original capital cost, at constant prices (that is, not allowing for inflation or rises in real costs). This includes all expenditures such as maintenance; insurance; fuel, oil, water, stores and gear; salaries and wages of officers and crew; an appropriate share of the costs of management and overheads. They include no interest on the original capital, or profit, but they do include an allowance for depreciation.

7.1.3 The first reaction to these figures, by those who do not have access to similar information, is that they are high. They will not surprise the operators of commercial fishing vessels of similar size and type. There are fisheries, for example, where the gross annual earnings of a new commercial fishing vessel under command of a good fisherman are expected to be from, say, two-thirds of her capital cost up to a sum equal to her capital cost; in the same fisheries, the best vessel may catch up to three times as much as the poorest performer, so that the average vessel may be expected to gross roughly two-thirds as much as the top vessel; in these same fisheries, again, average profits have tended to zero; if so, average annual operating costs must be roughly from something under half to about two-thirds of the capital cost of a new vessel.

7.1.4 The main conclusion is that those considering the acquisition of a fishery research vessel must accept, and arrange for, the commitment of sums to cover annual operating costs equal very roughly to half her capital cost every year. As will be explained later below, there is little prospect of achieving substantial savings on this in more than the very short term.

It follows that in order to get value for money, vessel availability and utilization should be very high.

7.2 Standards of Maintenance

7.2.1 The above figures relate to vessels, the availability of which (readiness-for-sea), varies between "acceptable in the local circumstances", to "very high", and the utilization of which is usually high. All the vessels are maintained to standards equivalent to those required by the major international ship classification societies.

7.2.2 Maintenance costs and associated costs of supervision and survey form a substantial part of the total operating costs: roughly one quarter to one-third. In return for this expenditure, the operator has a ship that is as safe and reliable as when new, with as high an availability.

7.2.3 Sometimes a vessel operator attempts to reduce current expenditure by taking his ship out of class and reducing expenditure on maintenance to the level where only repairs are done, and perhaps only then if they are necessary in order to get the ship to sea.

In the leading maritime nations, such a situation would soon bring in the inspectors and surveyors of the national maritime safety authority, who would re-impose standards not very different from those of the classification society.

However, that is not the most important point. It is that failure to maintain the ship to reasonably high standards will result in rapid loss of capital value as well as of availability, and the ship will have to be replaced all the sooner, or undergo expensive repairs and refit.

A new ship has to be sufficiently strong, safe and reliable to face her first storm, but an old ship still has to be sufficiently strong, safe and reliable to survive her last storm. Without regular inspection and maintenance, a ship quickly deteriorates in these respects, and to restore her to an acceptable standard of safety and reliability after a period of neglect of only a few months may cost a great deal of money.

There is no way of avoiding the expenditure on maintenance, without incurring equal or greater costs - not even by laying-up the ship.

7.3 Laying-up out of Service

7.3.1 Contrary to what the layman might suppose, it is by no means always the case that savings can be made by laying a ship up out of service. There may be a temporary slowing-down in current expenditure on fuel, but this will be offset by increased expenditure on harbour dues and the like, and by eventual additional expenditure on maintenance.

A ship tied up in harbour deteriorates more quickly than one at sea. The causes include condensation in structure, machinery and equipment including electronic equipment; drainage of oil from lubricated surfaces; other effects on machinery bearings and seals. There will be consequential effects, and more rapid fouling and/or corrosion of the hull; there is an additional likelihood of minor collision damage, pilfering and so on. There will be a need to open up and inspect machinery and equipment before the ship can be put to sea again, and to take remedial measures. Some of the effects can be prevented or reduced by providing heating (and air conditioning) and by frequent running of engines and turning over of machinery. To protect the ship completely, however, it is necessary to undertake the expensive and elaborate process of mothballing or cocooning, with all vulnerable surfaces and materials given special physical and chemical protection.

7.3.2 Some money can perhaps be saved by paying off officers and crew. This, however, is short-sighted for a number of reasons. The principal reason is that the officers and crew of a fishery research vessel should have been chosen in the first place for their particularly wide knowledge, experience, versatility and range of skills, and will in any case have acquired additional skills and experience possessed only by the officers and crews of fishery research vessels and necessary for the safe, effective and efficient performance of their duties.

Second, the attraction of a job in the public service is not usually or only the pay, but the permanence. Third, unpredictable and arbitrary pay-offs will make it all the more difficult to recruit good officers and crew when money is once again available to pay them, and their enthusiasm for the task and for keeping the ship smart and in good order will not be the same.

7.4 Repair and Maintenance of Scientific Equipment

7.4.1 The costs of operation of the ship should include the costs of repair, maintenance and modification of most of the scientific and technical equipment that can be regarded as fixtures, that is, built into the ship and purchased as part of the ship: hydrographic winches; refrigerating condensing units.

Where the apparatus or equipment is portable, or only temporarily on board (microscopes; desk-top computers; pilot plant) the costs of repair, maintenance and modification should fall on the appropriate project(s) in the research and development programme.

7.4.2 The technical responsibility for the maintenance of the scientific acoustic apparatus will, like its operation, lie with the scientific staff. For this reason, the cost of maintenance, repair and modification of scientific acoustic apparatus should be borne on the research budget, even if it is a "fixture", but associated dry-docking should be charged to the ship.

8. UTILIZATION AND AVAILABILITY

8.1 Utilization

8.1.1 With capital and operating costs so high, it is incumbent upon the owners of fishery research vessels to ensure that they are utilized as fully and effectively as possible.

8.1.2 Large ocean-going commercial fishing vessels can achieve 300 to 320 "days at sea" in a year (these figures are according to a convention that the day of departure from port and the day of arrival are both counted in full, and if the catch is not landed until the day subsequent to the day of arrival, this is counted also. The actual duration of a voyage, in multiples of a 24-hour day, is on average roughly two days less than the conventional figure).

Some commercial fishing vessels of 15 to 25 m LOA, making more or less weekly trips, sailing on Monday and landing on Friday, achieve up to 240 "days at sea" in a year, using the same convention.

8.1.3 The research vessel cannot be expected to achieve always as many days at sea in a year as her commercial counterpart, because some additional time is likely to be required in port for removing and replacing scientific equipment, servicing the scientific acoustic apparatus, installing and testing pilot plant and other experimental installations and removing them again.

It is also possible that in some cases the requirement for the services of a research vessel is seasonal, or that because of weather or other factors the vessel has to be laid up for some period of every year.

If, however, after making allowances for these sorts of things, it appears that the research vessel is not as fully utilized during the working season as are the vessels of the commercial fishing fleets, it may have to be concluded that there are defects in administration and management, and that full value is not being derived from the capital investment.

The two sub-chapters immediately following are devoted largely to discussing the problems of achieving high and effective utilization of fishery research vessels. First, however, it is necessary to distinguish between utilization and availability.

8.2 Availability

8.2.1 By availability is meant the number of days in the year when the vessel was (or could have been) ready-for-sea, including the days she actually was at sea.

If the number of days for which the vessel is actually utilized is much smaller than the number of days for which she was available, the explanation is probably to be found in poor planning and execution of the sea-going activities in furtherance of the research and development programme (after due allowance has been made for any planned utilization of the vessel for purely commercial fishing - see later below).

If the number of days when the vessel was ready-for-sea was less than assumed in the plan of operations, then, apart from accidents or unforeseen and unavoidable technical troubles, the explanation has to be found in the administration and management of the vessel.

8.2.2 Some fishery research vessels achieve less than 100 days at sea in a year, some, much less. Too often, however, this is dismissed as due to "lack of financial provision" or "lack of spare parts", without any enquiry into whether the administrative and financial procedures are suited to the operation of fishery research vessels and capable of producing better results, or whether management policies and practices could be changed for the better.

8.3 Planning and Control

8.3.1 The subject of planning the annual programme of seagoing activities is covered in other documents in the series. Here it need only be said that the programme for a research vessel, including both research and development work and any purely commercial-style fishing, should be based on a realistic forecast of the vessel's availability. This should be agreed by the director of research and development and the fleet manager.

8.3.2 Accurate records should be kept of availability and utilization for past years. They should include a specific detailed explanation as to why the vessel was not available for every single day that this was the case, and also an explanation, if she was available but not utilized, of why this was so. This record should be reviewed by the director of research, the fleet manager and the officer locally responsible for finance and administration at, say, three-month intervals, and compared with previously-agreed targets.

8.3.3 Those responsible for the management and servicing of the vessel should be set an agreed target of availability, based partly upon the recorded experience but also and more especially upon the performance known to be achieved in well-managed fleets of research vessels.

For large research vessels of, say, 36 m LOA and upwards, a suitable target for availability would be 200 to 240 days a year. For smaller vessels down to, say, 20 m LOA, a suitable target for availability might be 160 to 200 days a year. Such figures are regularly achieved.

The actual target figure will, of course, have to be adjusted to local circumstances; it is important, however, that the director of research and the fleet manager distinguish between circumstances that are man-made and can, at least in theory, be changed, such as inappropriate administrative and financial policies and procedures, or local lack of skills and facilities, and circumstances that are beyond the power of anyone to change.

9. FLEET MANAGEMENT: OBJECTIVES AND RESOURCES

9.1 Objectives

9.1.1 The primary objective of fleet management should be to maintain the operational effectiveness of the research vessel or vessels, so that they are available whenever required for the execution of the sea-going activities of the research and development programme (and for commercial-style fishing if this is done).

In practical terms this objective should be expressed as a figure for availability to be attained during the current year, as suggested in 8.3 above.

9.1.2 It will be clear from what has been said earlier above that achieving high availability will also serve three other objectives, namely:

(a) to attain as long as possible a useful working life for an expensive capital asset,

(b) to maintain the capital value of the asset as high as possible,

(c) maintaining safety and reliability.

9.1.3 To maintain operational effectiveness it will also be necessary to:

(a) develop and preserve, through training and in other ways, the skills of operating the vessels, the fishing gears and the equipment on board, and

(b) plan and execute modifications and improvements to the vessel(s) as may be necessary or desirable and as opportunity offers.

9.1.4 Another important task of fleet management is to assist the director of research and development to utilize the vessel(s) as fully and effectively as possible by providing technical advice and assistance in the planning and execution of his sea-going programme, especially with respect to fitting of experimental apparatus, pilot plant, deck equipment for new fishing gears, etc.

9.1.5 Other objectives might be:

(a) to achieve the foregoing objectives with reasonable economy

(b) to develop and maintain a capability for planning new facilities for research and experiment at sea (see 2 above).

9.2 The Fleet Manager

9.2.1 The attainment of these objectives and the supervision of the tasks involved should be the responsibility of a designated official within the fisheries research and development organization. Since the capital value and operating costs of the research vessel(s) are likely to represent a substantial fraction of the organization's budget, the designated official should be either the director or a senior member of staff.

9.2.2 These responsibilities cannot be delegated to someone outside the organization, even to the manager of a research vessel pool, not so much because of the comparatively large sums of money involved, but rather because the availability of the research vessel(s) is essential to the execution of the organization's programme. The person responsible for the availability of the vessel(s) must therefore be committed to the organization, share its objectives, and be dependent for his professional reputation and the success of his career on the part played by the research vessel(s) in the execution of the fisheries research and development programme.

Where the professional management and maintenance of the research vessel(s) is farmed out to a vessel pool or to outside contractors, it must be clear that the responsibility for seeing that the vessel(s) is available when required still rests with the designated senior official within the fisheries research and development organization. It follows that he should be able to recommend changes in the arrangements if he is unable to achieve his objectives.

9.2.3 The individual concerned may be the director, his deputy or a senior administrator. He will need professional, clerical and administrative assistance in executing his responsibilities. This may be provided from within the organization or by a research vessel pool.

9.3 The Management Team and its Functions

The number of members in the management team will depend on the size and number of vessels and on the local style of administration. Their qualifications and duties, however, will be as follows:

9.3.1 The key man in the management team is the marine engineer superintendent. He should possess an internationally-recognized First-Class Certificate of Competency as an Engineer Officer in the merchant marine, should have several years' experience as a sea-going officer and some years of experience in fishing vessel maintenance.

On this individual will rest the main technical responsibility for seeing that the vessel(s) is ready for sea. He will act as the main representative of the owners in negotiations with, and supervision of, firms or other government organizations contracted or employed to carry out maintenance, repairs and modifications, and will supervise such maintenance as is carried out by direct labour. He will advise as necessary on special questions of safety (6 above), insurance and other technical aspects of ship management.

9.3.2 A clerical assistant or assistants - depending on the number of vessels - will be required to keep financial records; control, order and issue spares and stores; and conduct the correspondence with and on behalf of the ship(s) which, if of any size, will be substantial in volume.

9.3.3 A nautical superintendent, marine superintendent or "ship's husband" is required to deal with such matters as mustering the crew(s) at the correct times; leave rosters; berthing and security of the ship(s) in harbour; putting on board of stores, ice, food, fishing gear, etc; supervision of stores of fishing gear, cordage, etc., belonging to the ship(s); and supervision of the net loft, if this is not under the control of fishing technologists.

This man should be a former masterfisherman or former first officer (mate) in a commercial fishing vessel, so that he has an understanding of fishing gear as well as of nautical matters in general. (In cases where there is only one, or perhaps two, vessels in the fleet, it may be convenient for this man to act also as a relief for the regular first officer or second officer of the vessel, when any of the officers are on leave, sick or otherwise absent from duty.)

Depending upon the number of ships, this man will require the assistance of one or more "ship's runners".

9.3.4 The rank or grade and seniority of the above individuals, and the number of qualified deputies or assistants they may require, will depend upon the size and number of research vessels and their deployment, and on local styles of administration.

Where there is a fleet of research vessels dispersed at various points on a long coastline, it will be very highly desirable to have in each of the ports in question a "ship's husband" and a clerical assistant; it will also be very desirable to have a deputy marine engineer superintendent.

If a research vessel is moved from time to time from one base to another, it is very highly desirable that the nucleus management team associated with that particular vessel should move with her.

9.3.5 The best assurance of achieving high vessel availability and the other objectives noted in 9.1 above will be if the management team is located within the research and development organization itself and if its leader - the marine engineer superintendent - reports directly to the senior official designated as fleet manager (9.2 above).

If the organization operates only one or two vessels, or if the vessels are rather small and simple, the tasks of fleet management may not be enough to occupy the management team fully. This is not to be taken as a reason for dispensing with the services of such a team, in whole or in part: research vessels are, or should be, too important. Compared with their operating costs, the salaries of the team will be small. The answer is to give the marine engineer superintendent other responsibilities in addition as, for example, for the laboratory workshops, for motor transport, for building maintenance. The first priority, however, should be the research vessel(s).

9.3.6 An alternative is for the functions of the management team to be performed by an external vessel pool management within the public service. This, however, is only acceptable if the vessel pool is mainly a fishery research vessel pool, and the management possess not only the qualifications but also the experience and background laid down in 9.3.1 and 9.3.3 above.

If the management and maintenance are undertaken by some organization lacking this experience and background (as for instance, the organization maintaining fishery patrol vessels or customs vessels), the results are not likely to be satisfactory unless the fisheries research and development organization has a vessel management team, as defined above, on its own staff. Only such a team will possess a thorough appreciation of the research organization's particular requirements and objectives and be able to represent its interests in all transactions with the service organization; it will only be able to do so effectively if it possesses the necessary professional and technical expertise.

9.3.7 This applies especially if the management and maintenance of the research vessel(s) are farmed out to a company operating a commercial fishing fleet, which in many other ways appears to have advantages. The danger is, that whatever agreements are reached at higher levels of management, and whatever undertakings are given, the executive managers of the fishing company will try to give priority to their own vessels, and especially to the vessels commanded by the better skippers, in such matters as berthing; putting on fuel, ice, water and stores; maintenance, repairs, spare parts, dry-docking; supply of relief crew and so on. It is therefore necessary for the research and development organization to possess a vessel management team to represent its interests on the spot and at all times.

9.3.8 It is also necessary in any case, where the management and maintenance of a research vessel(s) is farmed out to another organization, to monitor and control that the fuel, stores, labour, spare parts, paint, etc., charged to the account of the research vessel(s), were in fact required and were in fact delivered or supplied. To ensure this, it is necessary for the fisheries research organization to have a vessel management team of its own, with sufficient qualifications and experience to protect the organization's interests by monitoring and controlling such matters in detail.

9.4 Other Essentials

9.4.1 The objective of fleet management will not be achieved without provision of certain other resources. The main requirement is for adequate financial provision, on the scale indicated in Chapter 7 above.

9.4.2 Other resources required include a sufficient local pool of engineering and other skills to carry out routine maintenance and small repairs. In some cases it may be necessary or convenient for these to be undertaken by the officers and crew themselves, assisted as may be required by the members of the management team.

9.4.3 Supply of spare parts and other stores can be a problem in some developing countries, sometimes because of lack of interest on the part of the local agents but more often because of foreign exchange controls or the slowness of handling imported cargo and clearing it through customs.

A wise precaution, therefore, is to ensure that a new vessel is delivered with a very adequate supply of all spare parts, components and stores likely to be needed to allow maintenance and repairs to be carried out for, say, the first two years; these will be in addition to those required by the classification society and national maritime safety authority, and those recommended as sea-going spares by the machinery manufacturers.

An ample stock of spares, etc., will allow time for the necessary negotiations and procedures for their replacement as they are consumed, before they become exhausted.

9.4.4 The administrative and bureaucratic pitfalls sometimes encountered in obtaining spare parts and other imported stores are only one, and perhaps not the most awkward, of various problems of this kind that can be encountered by the fleet manager and his team in their attempts to achieve their objectives. Often, the administrative and financial policies and procedures enjoined upon, or found within, fishery research and development organizations, are inappropriate or inadequate when dealing with ships, especially if high importance is accorded to the readiness-for-sea and degree of utilization of the vessels.

10. FLEET MANAGEMENT: ADMINISTRATIVE AND FINANCIAL CONSIDERATIONS

10.1 Provision of Finance

10.1.1 The prime requirement for achieving the objectives of high availability and utilization, and making effective use of the capital investment represented by a research vessel, is specific provision of finance for her operation. The scale of provision required is, very roughly, half her capital cost in every year, on average, as noted in 7 above.

10.1.2 A practice exists, or has existed in some countries, of making no specific, separate provision of finance for the maintenance and running of the vessel; instead, the necessary sums are found out of the budgets of individual research projects. This achieves the objective of making the scientist in charge of the project aware of the costs, but it achieves it at the expense of vessel availability, reliability and safety, and accelerated deterioration: with such arrangements in force only the minimum of repairs and maintenance necessary to get the vessel to sea are likely to be done; regular, routine maintenance and inspection, and the periodic overhauls and refits demanded by the classification societies and the national maritime safety authorities, essential if the vessel is to remain in good condition for a full working life, cannot be provided for in this way.

10.1.3 The proper method of reconciling the need for regular, routine maintenance and overhaul, with the need to bring home to the research and development workers how much the vessel really costs, is to make an account-book transaction in which the research projects are "charged" for ship time on the basis of the historical costs per day at sea for the previous accounting period, adjusted as far as may be possible for expected changes in costs and in vessel availability.

In this system the sums required to cover the operating costs of the vessel will appear as a separate item in the budget. What proportion of this should be "recovered" from projects may be a matter of administrative decision.

10.1.4 The "value" in money terms of a day at sea can be regarded, for certain purposes to be discussed immediately below, as the sum of the operating costs, plus capital depreciation per day at sea projected over a twenty-year life, plus the vessel's share of the costs of the fleet management team, plus the average costs of the scientists on board (salaries plus overheads). This figure should be calculated on the basis of historical records, say, once a year.

Another measure of the "value" of a day at sea is the likely value of the catch per day at sea if the vessel had been fishing commercially. If the vessel never does fish commercially, then equivalent figures relating to vessels in the commercial fleet of the same size, type and power may be used.

The aim in both cases is to provide some measure of the value of lost time, such as for example the days when the vessel is available but not utilized. The fleet management team should, when opportunity offers and occasion so justifies, remind those responsible for the planning and execution of the sea-going programme of the value of ship time thus calculated.

10.1.5 Days at sea can also be lost because the vessel is not available, that is, not ready-for-sea. In such cases the fleet management team may themselves have to be reminded of the value of the lost ship time.

However, all too often the vessel is not available because of administrative delay. Here again, it may be useful to remind those responsible of the value of ship time, but see also 12.2 below.

For a 35 to 40 m LOA fisheries research vessel with an original capital cost of, for example, 5 million US dollars, available on 250 days of the year, the value of the ship's time is likely to be something between 10,000 and 20,000 US dollars a day. For a vessel of 18 to 20 m LOA, costing 800,000 US dollars, available for 160 days in a year, the value of the ship's time is likely to be between 2,500 and 5,000 US dollars a day.

10.1.6 The failure to make adequate financial provision for operating costs and especially for regular maintenance, inspection, overhaul and refit (10.1.2 above) is only one of several ways in which inadequate or inappropriate administrative arrangements may result in lost ship's time through reduced availability. Others will now be discussed.

10.2 Policies and Procedures

10.2.1 The rules and procedures for the expenditure of public funds are usually devised with four main things in mind: first, that no commitment to expenditure will be entered into until the proposal has first been examined to ensure that it is an appropriate subject for expenditure, authorized by the government; second, that correct procedures have been followed; third, that the sum expended will be the minimum possible; fourth, that the expenditure will be fully accounted for and supported by all the necessary vouchers, certificates and approvals. Such procedures have little or no regard to the cost of time. When time costs as much as indicated in 10.1.5 above, they may need to be modified or adapted. This can usually be done without offending the general principles of public accountability or losing sight of the need for making the best possible use of the taxpayer's money.

10.2.2 One very common rule is that in transactions of even quite small value, competitive tenders (bids) have to be invited.

If there is only one local agent of the manufacturer of a radio, an echosounder, an engine or a hydraulic pump, and only he possesses the knowledge, skills and spares necessary for its servicing or repair, there is no point in entering into correspondence on each occasion as to why three tenders have not been submitted. An even more extreme instance is when spare parts are ordered directly from the manufacturer. A blanket authorization to place orders with named agents and manufacturers in this category should be issued and quoted when transmitting bills for payment; the authorization should be reviewed at, say, yearly intervals.

10.2.3 A more frequent and more important cause of delay is to call for tenders (bids) every time maintenance work or repairs are required and every time fuel or lubricating oil is bought. This also has the possible effect of the ship being serviced on succeeding occasions by different people, which will not be conducive to quick and well executed work.

A more appropriate procedure in such cases is to call for bids only once a year, or at even less frequent intervals. In the case of contracts for repairs and maintenance, the basis of the tender (bid) will be hourly costs of labour, costs of other common inputs, overheads and profit margin. In the case of fuel, the bids will be in terms of price per ton.

10.2.4 Ships often find themselves in ports other than their home port - sometimes in foreign ports. In case the vessel finds itself in a port where the owners have no representative or agent, the Master can be given the authority and the means to disburse sums on pilotage, harbour dues, small quantities of fuel, water, stores and food, police or court fines, medical attention for sick or injured and travel tickets for crew members called home on emergency compassionate grounds. These sums must, of course, be accounted for, with supporting vouchers. Fuel and water prices can be checked; fuel consumption can subsequently be checked by comparison with records or by calculation from estimated powers and times.

Such an arrangement will help to ensure that as little time as possible is wasted in foreign ports or strange ports. It does not and should not cover normal transactions in the home port or ports, which should be conducted by the fleet management team - the master and other officers will, after all, be on leave during the time that the vessel is being refuelled, revictualled and generally serviced, and will probably be at sea again when the bills are presented.

10.2.5 Delays and loss of ship time occur during normal operation, using the home port as base, if the management team do not possess sufficient authority to order fuel, water, stores, ice and so on, or to commission repairs of a minor sort, or routine maintenance and obligatory inspections and overhauls. If the financial authority is retained further back in the administrative chain of command, there are almost bound to be delays, if only because ships come and go according to the tide tables and work on them is not normally suspended at weekends: normal office hours and the normal working week are irrelevant. The real costs of such delays, in terms of lost ship's time, will be very much more than any possible savings that might be achieved by withholding financial authority for routine transactions from the fleet management team.

In any event, it is doubtful whether withholding financial authority from the fleet management team constitutes any additional safeguard. The management team will have apparently irrefutable technical justifications for much of the expenditure they propose, with which an administrator will find it difficult to argue. However, the fuel and oil consumption of engines should be known; the amount of water and food consumed by a crew member should be known; items like paint can be controlled by proper records and operation of a "closed" store-keeping system; sudden apparent increases in the need for supplies of a certain item or service can be investigated. Orders issued by the fleet management team can thus be checked. If they are checked in retrospect rather than in advance, the organization will benefit by having the ship ready-for-sea all the sooner.

10.2.6 The best arrangement for ensuring that ship's time is not lost by unnecessary delays is a logical extension of that just described. If it is accepted that, in all circumstances, it is in the best interests of the organization that the ship be made ready-for-sea as quickly as possible, then the fleet management team should have the authority to order any stores, work or services seen to be necessary to that end. Any investigation as to whether and, if so, why, the proper rules and procedures were not followed in a particular instance, should take place after the event, so that discussions and correspondence on such questions do not cause costly delays.

10.2.7 Where the government operates only a simple system of cash accounting, the cost of delays may appear to be small; indeed, the administrator responsible may even persuade himself that by keeping the ship in harbour he is saving money. This can be true in only the most narrow and short-term sense - temporary savings in fuel, for example. Such a view completely ignores the costs represented by officers, crew and scientists who should be at sea, the back-up facilities they would be using, and the capital and maintenance costs of the vessel; as already noted, the maintenance costs will be higher when the ship is laid up. That is to say, if a research vessel is acquired, with all the associated staff and facilities, it is good economics to use her as intensively as practicable.

All concerned should be reminded as frequently as may be necessary of the real costs of ship time.

10.3 Spares and Service

10.3.1 Delays in making the ship ready-for-sea may arise through failure to make available, when required, spare parts and skilled service. The failure can sometimes be administrative.

10.3.2 Reference has already been made to possible delays in clearing spares through customs; in 9.4.3 above, it was suggested that it may be a wise precaution to carry a large stock of all spares and material that may conceivably be required, say up to two years' estimated supply. Steps should, of course, be taken to replace each item as soon as it is drawn from store for use.

10.3.3 There may be restrictions on the use of foreign exchange which inhibit the ordering and import of spare parts and paying for the travel and the employment of skilled foreign experts. While it may be agreed that strict control is necessary, it can equally be said that to take the decision to acquire an expensive research vessel without at the same time making the necessary arrangements to ensure supplies of spares and skilled service shows a lack of administrative foresight and skill. A fishery research vessel will place little burden on the balance of payments in this respect, when compared, for example, with the needs of airlines and the defence forces.

10.4 Crew Incentives

10.4.1 If the officers or crew are unwilling to go to sea, delays are inevitable. The occasion of the delay may be alleged or suspected defects in machinery, steering, pumps, etc.; or delay may be engineered by neglecting to do things that should have been done; other causes are failure of crew to report for duty on time, and alleged illness; in some instances there may even be minor sabotage.

10.4.2 The commonest cause of such attitudes is that the officers and crew are paid the same amount whether they go to sea or not. In some cases, where the crew are charged for the food they consume at sea, they may actually be better off when in harbour, if they then have access to cheaper food.

10.4.3 There should be a positive incentive for the crew to go to sea. The incentive can take more than one form. The simplest and most straightforward is an allowance or bonus based on the number of days at sea. To compensate in part for weekends or official holidays spent at sea the allowance may be increased or else time off may be allowed in lieu.

10.4.4 In some cases it may be possible for the crew to share in the proceeds from sale of catches. The problem in such cases may be that the crew's expectations of income from this source are such that they are unwilling to undertake cruises during which little or no "commercial" fishing takes place. A judicious balance may have to be struck between incentive payments per day at sea, on the one hand, and payment for extra work arising from commercial-style fishing and based on some agreed share of the proceeds from the sale of catches, on the other.

10.5 Incentives for Scientists

10.5.1 What applies to the officers and crew may apply also to the research and development workers, especially the more junior grades and technicians who cannot expect benefits by way of publications, enhanced scientific reputation and so on.

10.5.2 The justification for paying seagoing allowances to scientific and technical staff is, partly, that they may be involved in expenditures on warm or waterproof clothing and other extra comforts such as items of food and drink, that would be unnecessary on shore; that the conditions in which they live on board involve a certain degree of physical hardship; and that they are deprived of some of the normal amenities of life enjoyed by people of similar qualifications working ashore.

10.5.3 The incentive may be partly in the form of a money allowance based on days at sea and partly in the form of time off in lieu of weekends and holidays spent at sea.

11. OFFICERS AND CREW

11.1 The Master

11.1.1 There is no universal agreement on what qualifications and background are necessary or desirable for the Masters of fishery research vessels, especially the larger ones built for deep-sea operations.

Some fishery research vessels are commanded by fishing skippers or masterfishermen, some by master mariners; the practice may vary within the research vessel fleet of a single country. It does not necessarily conform to the practice in the local commercial fishing fleets.

11.1.2 In former days, one of the arguments for appointing a master mariner as Master, rather than a masterfisherman, was that the former were very much more highly skilled in navigation; the Masters of fishery research vessels in some cases were authorized to certify the need for alterations to the official navigational charts. In these days of electronic navigational aids, and the better training of masterfishermen, this argument carries much less force.

A more telling argument is that in many countries it will be easier to recruit a master mariner of high calibre, who for one reason or another wishes to take up a post where absences from home are shorter than in the ocean-going merchant service, than it will be to attract a masterfisherman of equivalent ability, unless special and unusual arrangements are made regarding the scale of pay offered - see later below.

11.1.3 In some countries, of course, large deep-sea commercial fishing vessels are commanded by master mariners, but the experience of other countries with distant-water fleets is that this is not really necessary. The deciding factor in some developing countries may be that the fishery research vessel is so much bigger and more complex than any in the existing commercial fishing fleets that it will not be appropriate to appoint a commercial masterfisherman to her command unless he undergoes a long and rigorous training for the job, and acquires a certificate of competency in some country where commercial fishing vessels exist of the relevant size and type.

11.1.4 The better solution would seem to be for the Master to be a masterfisherman, if appropriately qualified masterfishermen are available, if only because this will save providing accommodation for two extra individuals: a master mariner and his deputy and relief.

11.1.5 Except perhaps in those countries where it is the custom for large deep-sea commercial fishing vessels to be commanded by master mariners, it might be difficult to persuade a masterfisherman of high ability to serve under another individual of different background and skills.

11.2 The Masterfisherman

11.2.1 The masterfisherman (the senior fisherman) on board a fishery research vessel - whether he is Master or not - is not always as knowledgeable, experienced and highly skilled as is desirable. This is a serious matter for the research and development organization operating the research vessel. Not only does it mean that the work will be carried out less effectively and less efficiently than is desirable but also, and more important, the results of the work will be judged by the commercial fishermen by the criteria they know best: the fishing performance of the research vessel and the personal reputation of the senior fisherman on board her, as a fisherman.

11.2.2 The difficulty in attracting a versatile masterfisherman of high ability, where it occurs, is due to the high incomes enjoyed by such individuals. Administrative civil servants find it hard to accept that an individual who has not even been to university should earn more than the Head of the Department, perhaps more than a Cabinet Minister. The result usually is a salary scale which attracts only a man long past his best, or a man with some deficiency in knowledge, experience or ability. Such men attract junior officers and crew of equally poor quality.

11.2.3 One arrangement that avoids this outcome is for the masterfisherman of the research vessel to be paid a salary which, taking into account pension and other emoluments, is equivalent to the average of the personal incomes in the previous year of the top (say, three) skippers in the local commercial fleet. A corollary is that he should be on a contract which allows his dismissal, or demotion to a normal public service grade, if his performance deteriorates. To attract and retain good crew will require similar arrangements.

11.3 Relief Officers and Crew

11.3.1 Where there is only one research vessel, careful provision has to be made so that the vessel's readiness-for-sea is not affected because individual members of her complement are sick, on leave or otherwise not available for duty. For the sake of morale, effective and efficient working of the ship, and good administration, the employment of casual relief officers and crew is to be avoided at almost any cost.

11.3.2 Reliefs should be provided primarily by appointing a First Officer who has the qualifications to act as Master if necessary. In vessels where the Master is a mariner and not a masterfisherman, the Second Fisherman should be qualified to act as Masterfisherman. The Second Engineer should be qualified to act as Chief Engineer. The ship's runner and/or some other junior members of the shore staff should be trained as and act as relief deckhands or greasers.

In emergency, the marine engineer superintendent and the nautical superintendent should be able to act as relieving officers in the engine room and on deck respectively.

11.3.3 There may be situations where routine maintenance and inspection, and minor repairs, have to be carried out by the ship's officers and crew. To the extent that the work cannot all be done at sea and has to be carried out in harbour, those involved may have to postpone or forego some of their shore leave. If monetary compensation is not acceptable, the system of leave and reliefs may have to be extended to cover an occasional "trip ashore" for those involved.

11.4 Discipline

11.4.1 The system and style of discipline necessary in a ship are sometimes different from those in the public service. The ship must take precedence, for legal reasons related to the Master's responsibilities; for the sake of safety; in order to ensure effective and efficient operation; and also because, otherwise, the positions of the Master and Chief Engineer become impossible.

11.4.2 The Master must have the authority to suspend from duty and to send ashore any of the officers and crew, either on his own initiative or on the advice of the First Officer or Chief Engineer. The individual should then be treated according to the normal disciplinary rules of the service.

If, in the opinion of the Fleet Manager, the Master shows good reason why the future presence on board of any such individual would be prejudicial to the safety or to the effective and efficient operation of the ship, the suspension should be continued and the case put before the Director of the organization (if he is not the Fleet Manager). If dismissal is not warranted by the rules of the service, the individual concerned should be disciplined as may seem appropriate and offered another post suited to his qualifications and grade, either in another ship or on shore.

11.4.3 The Master should not normally have powers of appointment or dismissal even of junior crew ratings except in cases of emergency as, for example, if in the course of a cruise the ship becomes too short-handed to complete the voyage back to home base. If the Master is allowed to hire and dismiss crew members as a regular procedure, there is no check on the qualifications, quality and suitability of the individuals; the filling of even the most junior posts should therefore be the concern of the fleet management team and fleet manager.

11.4.4 The fleet manager should have the authority to suspend the Master and order him ashore. In such an event the Master should have the right of direct access to the official next more senior in the line of management to the fleet manager, and to the official in charge of personnel and establishment matters. He should not be reinstated or dismissed without a hearing in the presence of the fleet manager and in accordance with the normal rules of the service; if the Master so wishes, he should be able to call expert witnesses of his own profession in his defence.

11.5 Pay

11.5.1 Sufficient has been said in 11.2 above about the need to set general levels of income high enough to attract a crew of good, skilled versatile fishermen. It has also been noted that only a good skipper will attract a good crew.

11.5.2 Even the best of crews will lose morale and proficiency if the vessel is not utilized at approaching the same degree of intensity (days at sea per year) as good commercial fishing vessels, after making allowances for the extra time in harbour as a result of scientific and experimental requirements. However, on the other hand, even good fishing crews need incentives to go to sea. The forms these might take have been outlined in 10.4 above.

11.5.3 If the money incomes of officers and crew fluctuate because of the varying incidence of seagoing incentives, there may be an apparent problem regarding the basis upon which any pensions or long-service gratuities should be calculated. Probably the most satisfactory solution is to link the pensions and gratuities to the normal pay scales of appropriate general-service grades in the public service.

12. SALE OF CATCHES

12.1 General Considerations

12.1.1 Some fishery research vessels are equipped to fish in a more or less commercial fashion and to bring their catches back to port. The legal aspects of selling such catches are dealt with later below, some financial and other aspects immediately below.

12.1.2 The original purpose of equipping a vessel in this way may be to facilitate experimental work on handling and stowage of the catch. Less often has there been a deliberate intention to utilize the vessel for commercial fishing for part of the time, if only because this might have been held to imply that the case for acquiring a research vessel in the first place was not very strong. However, there are situations where the main demand for vessel time for purposes of research is seasonal and it may be sensible to think of utilizing it for commercial fishing at other seasons. Experience also shows that, in some fisheries at least, certain kinds of scientific work can be combined with commercial fishing on the same cruise.

12.1.3 In the past, insufficient consideration has been given by owners and operators of fishery research vessels to the possibilities of commercial fishing, or to the potential advantages. The advantages are not merely financial.

12.2 Advantages

12.2.1 No fisherman will fish commercially unless he gets whatever share of the proceeds of sale is customary in the commercial fleets. This, as remarked earlier, provides a powerful incentive for the crew to go to sea.

12.2.2 The prospect of additional earnings will also induce the skipper and crew to fish something like as intensively as those in commercial vessels. They will therefore retain their proficiency and skills and remain highly able and versatile fishermen. What tends to happen in a research vessel that does not fish commercially is that the skipper and crew subside into an easy-going routine and not only fail to acquire and practice new and improved methods but gradually lose the speed and skill that they once had. They then lose any prospect of ever being employed again in the commercial fishery.

12.2.3 The ability to achieve and maintain commercial rates of working may possibly be of advantage sooner or later in programmes of technical development, as for example in testing new or improved equipment or methods for handling the catch, when commercial rates and volumes may be required to provide a realistic test. Even though the fishhold may not be as big in volume as that of a commercial vessel of the same general size and type, it should be possible to reproduce fairly well the conditions of stowage and patterns of spoilage of the catch that are found in the commercial vessel, provided that similar rates of catch and rates of handling can be achieved.

12.2.4 The other, and more obvious, advantage is that proceeds from the sale of catches can be regarded as offsetting, directly or indirectly, the costs of operation of the vessel(s) or the costs of fishery research and development as a whole. In view of the heavy costs of operation of fishery research vessels, this is an important advantage.

12.2.5 There is one additional benefit: the prospect of income will provide for the administrators and financial authorities a positive incentive, in terms they understand, to do their best to increase the availability and utilization of the vessel(s). Instead of the scientists and fleet management team harbouring feelings of frustration and resentment at delays caused by administrative and financial procedures, they may find themselves under pressure to get the ship to sea so that there will be more opportunity to earn money.

12.3 Problems

12.3.1 There is, indeed, a danger: the financial authorities and administrators, and the central treasury, may come to place too much emphasis on earning income for its own sake and forget or put aside the main purposes which a fishery research vessel is meant to serve. Such attitudes and pressures can be resisted by a strong director of research and he may be assisted by appropriate representations from commercial fishing vessel operators and others hoping to benefit from the results of the research and development programme. If too much vessel time is still taken up in commercial fishing, the next remedy may be to propose the acquisition of another research vessel.

12.3.2 It has been assumed so far that the operators of fishery research vessels have the legal powers to offer fish catches for sale. This is discussed further in a later chapter (see 14.4). Even if it is legal, however, it may not always be appropriate, politically acceptable or wise. The obvious case is where the research vessel is based at a port where the local commercial fishing vessels are much smaller and less powerful than the research vessel, or the local market for fish is vulnerable to over-supply. In such cases, if it is still necessary from time to time in the course of research and development work to take a big catch, it might be better disposed of to local schools, hospitals or orphanages, or to a local charity,or otherwise disposed of through non-commercial channels.

12.3.3 An apparent problem is that any income earned by departments of government usually has to be handed over to the central treasury, unless there is special exemption through legislation or waiving of the rules. This problem is more apparent than real, provided that the government recognises that the net costs of operation of the research vessel, or the net costs of fishery research and development, are less than the sum budgeted, by the amount of the income earned from sales of fish. The case is essentially different from those in which government bodies are enjoined to generate income by issuing test certificates, performing chemical analyses or providing consultancy services: these constitute part of the purpose for which such bodies are set up. Selling fish is no part of the objectives of a fishery research and development organization; it should be the result of making opportunistic use of an expensive asset at times when its main purpose has been temporarily fulfilled.

12.3.4 When the proceeds from the sale of catches have to be remitted to the central treasury there is a technical problem regarding what proportion should be remitted. It is quite clear that it cannot be 100 per cent of the proceeds of sales: there are costs in the selling of fish, and agents' commission; the officers and crew of the vessel will have to be paid their customary share of the proceeds; there will have been expenditure on ice, fishing gear, fuel and stores in excess of what would have been required had the vessel not been fishing commercially. Because of these complications, it may be simpler in the end for the central treasury to allow the fleet management to retain the proceeds from sales of catches and use them to defray part of the operating expenses of the vessel.

13. MARINE RISKS: INSURANCE

13.1 General Considerations

13.1.1 Many governments do not insure their property, including ships, taking the view that their enterprise is so big in total that it pays them in effect to insure themselves. This, however, does not necessarily extend to parastatal bodies, statutory government agencies, public enterprises or universities.

13.1.2 All shipowners face legal liabilities.

13.1.3 A special point for consideration is the likely presence on board fishery research vessels, from time to time, of visiting workers and others not in the employ of the organization owning and operating the research vessel, including foreign nationals (see 5.3 above).

13.2 Technical Considerations

13.2.1 Marine insurance is a highly specialized and technical business. The marine engineer superintendent, and the professional experts in the national maritime safety authority, will be familiar with the main risks and the general principles governing the provision of insurance cover but they will not be experts. If insurance is required, expert assistance will be needed from a reputable marine insurance broker, preferably one familiar with fishing vessels or oil exploration.

13.2.2 Even governments "self insuring" should seek the advice of experts on marine risks and marine insurance. Research vessel owners should also take note of the worth, or otherwise, of "hold harmless" clauses and "excess of legal liability" responsibilities. These terms and their implications need explanation by experts.

13.2.3 Insurers will almost certainly prefer that the vessel(s) be maintained "in class" according to the rules of an internationally-recognized ship classification society (6.2 above).

13.2.4 Not many years ago, it was extremely difficult and often impossible to get insurance cover for any piece of equipment that was lowered into the sea from a ship. This is fortunately no longer the case, so that fishing gear, towed bodies, submersibles and instruments lowered from oceanographic winches can be insured as well as the ship.

Special insurance cover can be taken for sea trials, such as the first shooting of expensive gear like large purse seines, or trials of new or improved gear, telemetry apparatus and the like, or of an unique prototype pilot plant.

13.3 Example

13.3.1 FAO employs reputable marine insurance brokers to obtain cover for the vessels of the UNDP Fishery Research Vessel Pool. Their experience may be useful to other owners of such vessels and their advice is available on request.

13.3.2 The items covered for the UNDP fleet include the following:

(i) Hull and Machinery
(ii) Added Value
(iii) Institute War and Strikes
(iv) Protection and Indemnity (Class I)
(v) Protection and Indemnity (Class II)
(vi) Excess of Legal Liabilities.

These terms are all highly technical, "Added Value", for example, is a means of increasing the "total loss" cover at a lower premium rating than "Hull and Machinery" - which itself is a technical term the precise definition of which requires the interpretation of an expert. The purpose of quoting the above list of items is to illustrate and emphasize the need for owners to seek the advice of experts in marine risks, whether they intend to seek insurance cover or not.

14. LEGAL MATTERS

14.1 Ownership

14.1.1 Some legal aspects of ownership are discussed in chapter 5 above. It is pointed out that a ship needs to be owned by a legal "person" or entity; also that legislation may be necessary to empower government departments and agencies, universities and the like, to own and operate ships.

14.1.2 The legal liabilities of shipowners should be discussed with expert consultants on marine risks (insurance) - Chapter 13 above.

14.2 Status of Vessel

14.2.1 In the eyes of those administering the law, a fishery research vessel is not necessarily a fishing vessel. They may regard it as a merchant vessel or a passenger vessel. This can involve the owners and operators in considerable difficulty and expense.

For example, in one case the various departments concerned with the administration of the shipping laws and the national regulations on safety of life at sea decided, independently of each other, that a new fishery research vessel operated by another department of government would be regarded for some purposes as a fishing vessel, for others as a merchant ship, and for yet other purposes as a passenger ship. The department concerned with safety required the kind of pumping arrangements for firefighting and other safety features, obligatory for passenger ships but not for other kinds of ship, because they regarded the scientists as passengers. Another department, concerned with seaworthiness, decided that although the vessel was of typical trawler form and would normally be engaged in fishing, she was not a fishing vessel because one part of the shipping law defined a fishing vessel as one that fished "for profit". The result was that a Load Line was allocated as if the vessel were a merchant ship. The statutory mark was painted on the hull, and incidentally was below the waterline when the ship was in the fully laden departure condition, thus bringing the law into disrepute. The effect of allocating a Load Line, however, was that the department concerned required all door coamings, bulwarks and hatch coamings to be of a height appropriate to a cargo ship; a special dispensation had to be sought to retain the low hatch coamings normal in a trawler in order to make the ship workable and avoid raising the trawl warps and winch to four feet above the deck. Fortunately, the department concerned with manning and with qualifications of officers agreed that, for these purposes, the ship should be registered as a fishing vessel.

14.2.2 The purpose of narrating the foregoing story is to emphasize the desirability of arriving at a clear understanding of the legal status of fishery research vessels. Ideally, the national legislation on shipping (or fisheries) should recognize a separate class of vessel, the fishery research vessel, or else it should stipulate that fishery research vessels should have the legal status of fishing vessels.

14.3 Exemptions

14.3.1 As remarked earlier above, legislation may exist exempting the government from compliance with its own laws in respect of the ships it owns and operates. Nevertheless the best policy may be for the government to show a good example to the operators of commercial fishing vessels by complying fully with the law.

14.3.2 Fishery research vessels do require exemptions from, or dispensations from compliance with, certain laws and regulations. These include the use of nets with meshes below legal minimum size; the use of other illegal methods of capture; fishing in forbidden areas (including military areas) or during closed seasons; fishing for protected species or varieties. The Minister or Head of Department responsible for fishery research should have powers to grant specific exemptions or dispensations for stated periods and in stated locations, after any necessary consultation with his colleagues in maritime transport or defence departments.

14.4 Enabling Legislation

14.4.1 The main enabling legislation required by the operator of a fishery research vessel is the power to catch fish and sell it as if he were a commercial fishing vessel operator. If the legislation can also authorize him to retain the proceeds of sale of catches for the purpose of defraying part or all of the costs of operation of the vessel or the costs of the programme of research and development, so much the better.

14.4.2 Other useful enabling legislation would empower the Minister or Head of Department to authorize the expenditure of foreign currency for the procurement of spare parts and services essential to the operation of fishery research vessels (and other expensive research facilities).

14.4.3 The organizations operating fishery research vessels should be authorized to operate radio telephone transmitters and receivers on appropriate frequencies, also to install on board the research vessel and operate radio navigational aids, radar and underwater acoustic apparatus, whether in a military zone or otherwise.

15. OTHER METHODS OF PROVIDING SEA-GOING FACILITIES

15.1 General

15.1.1 As indicated earlier, the ownership and operation of a research vessel is not the only possible way of carrying out sea-going activities in aid of a programme of fishery research and development.

15.1.2 There is a growing realization of the costs of operation of research vessels, and a search for other, cheaper means. Offsetting part of the costs of operation by engaging in commercial fishing when opportunity offers is another kind of solution which is also attracting greater interest.

15.1.3 Costs of operation are not the only consideration. There are certain kinds of activities which are likely to be carried out more effectively by the use of commercial fishing vessels:

(a) exploratory fishing for the purpose of providing information on which investment decisions, or decisions to redeploy an existing commercial fleet, can be based (as distinct from resource surveys for the purpose of estimating biomass and yield);

(b) technical development and operational assessment of new or improved methods and equipment (excluding purely experimental, laboratory-scale prototypes, but all stages of development thereafter, up to the stage when the results are immediately applicable by industry).

15.1.4 There are other kinds of investigation which by their very nature cannot be carried out except on board commercial fishing vessels. These include:

(a) observation of the methods and standards of handling and stowage of the catch with a view to proposing improvements

(b) observation of the environmental conditions in which machinery, equipment and men have to work, and the ways in which machinery and equipment are treated, to guide design and development

(c) observations intended to define in engineering terms what the operational requirements are regarding the performance and performance characteristics of machinery and equipment, including processing plant

(d) observations of the use of fishing aids, and the fishing tactics and decision-making processes employed by outstanding masterfishermen, for use in training and in the design of training aids

(e) observations related to health, working conditions, etc., on board fishing vessels.

15.2 Use of Commercial Vessels

15.2.1 As just suggested, the use of commercial fishing vessels has certain advantages for exploratory fishing and for certain kinds of technical development work and technical investigation. Among these are the greater understanding and mutual appreciation developed between the research and development workers and the fishermen who will be the users of their results; the greater certainty that the new or improved methods and equipment will be developed so as to be operationally practicable and acceptable; and the greater rapidity with which the results will be taken up by, and disseminated throughout, the commercial fishing fleet.

To achieve this outcome, certain conditions have to be satisfied.

15.2.2 The first necessary condition is that a suitable vessel or vessels must be available and the owners willing to cooperate. At first, they may be willing to do no more than allow one or two observers to make the occasional voyage, until some mutual confidence and respect is established.

15.2.3 The charter of a commercial vessel without her regular officers and crew, as a virtual replacement or substitute for a research vessel, is not considered in what follows, only the more common case of the charter of commercial fishing vessels, with their normal complement of fishermen, for carrying out certain kinds of research and development.

The most satisfactory basis on which this can be done is:

(a) the charterer compensates the owner fully for loss of fishing time, the rate to be based on the normal expectations of catch and price for that season of the year

(b) the owner informs the officers and crew accordingly, in the presence of the charterer, and undertakes to pay them their normal share of the compensation

(c) the charterer pays for the procurement and installation of any experimental equipment, fishing gear, etc., and undertakes to remove it and restore the vessel to its former condition when so required

(d) the owner has the option of retaining the experimental equipment, etc., at a price to be negotiated

(e) the results of the investigation are the property of the charterer.

15.2.4 The effective execution of the work depends crucially on the quality of the skipper and crew of the vessel concerned. The more successful the skipper as a fisherman, the more likely he is to be willing to cooperate with the research and development workers and to participate in the investigation; and the better he and his crew will play their particular parts in it. Moreover, the credibility of the results among the rest of the commercial fishing fleet, and the speed with which they will be disseminated and applied, will depend greatly upon how much respect the skipper enjoys among his fellow-skippers and amongst the vessel owners.

It is therefore good economics to charter a vessel commanded by a skipper of high reputation and skill. The charter fee will be correspondingly high, but a good job will be done. To invite tenders and select the lowest bid will produce a poor vessel of low availability with a correspondingly poor skipper and crew; the morale and dedication of the research and development workers will also suffer.

15.2.5 To give a vessel operator a contract to carry out an investigation on his own may produce results that are less satisfactory than might be hoped, indeed sometimes they may be unacceptable - even if the activity to be undertaken is exploratory fishing. Commercial fishing vessel operators are not usually accustomed to planning and executing research and development projects; the research and development organization should therefore retain control of the work. It must be planned in consultation with the vessel operator and supervised in its execution by the scientists, engineers or technologists responsible for that particular part of the research and development programme. In the same way, requests from vessel operators for financial support for "experiments" should be given only if the appropriate experts agree and approve the proposal and are closely involved with its execution.

15.2.6 To facilitate measurements of the performance and behaviour of various types of commercial fishing vessel and of their machinery and equipment, it is convenient to install instrumentation on a typical vessel. This may involve fixing transducers of various kinds in various parts of the ship, connected by cables to a central recording apparatus or data logger. Accommodation has to be found for the recorders and for any research and development workers on board.

This is best done when the vessel is still under construction but it can also be done during refit. The main point to be noted, for the present, is that permanent facilities of this kind for two observers and recording apparatus have been provided in a commercial fishing vessel of only 23 m LOA.

15.3 Research Vessel Pools

15.3.1 As noted earlier, the requirements for research vessel time will in some circumstances be greater in the early days of developing a new fishery and in the early days of assessing the stocks, than in later years. At the same stage of development, there may be a lack of local skills and experience in the management and servicing of fishery research vessels.

15.3.2 In such cases, it may be appropriate to seek technical assistance, not only in the form of international experts but also in the form of a research vessel with crew and fleet management services. The provision of assistance of this kind through a vessel pool is already a long-established activity of FAO and UNDP, and of some bilateral technical assistance agencies. With the rising costs of research vessels, the system is likely to become more common.

15.3.3 The operation of research vessel pools by groups of countries may effectively lower the cost of sea-going fishery research for each participating country. Such arrangements would also enhance the exchange of expertise and knowledge between the countries concerned, in the spirit of TCDC.

16. CONDITIONS FOR EFFECTIVE UTILIZATION

16.1 The Research and Development Function as a Whole

16.1.1 The owning of fishery research vessels is not an end in itself, although sometimes they appear to be regarded mainly as a source of prestige.

16.1.2 A fishery research vessel is only one part of a system for gathering information from the sea, storing it, processing it, deducing results and drawing conclusions and recommendations from them. It is useless if the other parts of the system are not in place, and only partly useful if any of these are inadequate, defective or missing.

16.2 Successful Utilization of Research Vessels

16.2.1 The prime essential for effective utilization of the vessel(s) is a staff of well-qualified research and development workers possessing adequate experience. A sufficient number of these must be available, able and willing to go to sea, as discussed in 3.8.4 above.

16.2.2 The exigencies of that part of the programme of research and development concerned with the utilization of fish and fish products are likely to be such that there is only an occasional need for the food scientists and technologists to go to sea, although there may be plenty of practical work to do at sea on handling and stowage of the catch and on other matters of interest to engineers. Because they are likely to go to sea less regularly than the fisheries biologists, there is more of a risk that the food scientists and technologists will be ineffective through seasickness. A highly successful solution adopted by the Torry Research Station was for most of the sea-going, especially in commercial vessels, to be carried out by a special team of marine engineers. It was still necessary for the scientists to go to sea from time to time, if only to ensure that they had a correct picture of what conditions were like.

16.2.3 Scientists need laboratories and apparatus; engineers need test beds and experimental workshops; fishing technologists need net lofts and electronic workshops. However, it is not unknown for the staff responsible for the execution of national fisheries research and development programmes to be housed in office buildings in the middle of cities (in one case not several hundreds of yards, but several hundred miles, from the sea). In such conditions there is less likelihood of effective utilization of the research vessel(s).

16.2.4 If the research and development workers are to utilize the vessel(s) effectively and serve the fish industry and the economy adequately, there must be effective methods of formulating the research and development programme and supervising its execution. In the more advanced fishing nations these include arrangements for consulting the user and supplier industries and for obtaining scientific and technical advice from outside the organization. Essential elements are a fisheries directorate that understands the purposes and methods of scientific research and technical development, and a senior scientist or technologist research director with sufficient experience, and an impressive enough record of achievement, to command the respect of the younger research and development workers who will actually execute the programme, as well as of his administrative superiors. Otherwise, the research and development organization may find itself subjected to sudden changes of programme in response to pressure from industry or politicians, including diversion of research vessels from one area and one task to another, before sufficient data have been gathered to allow conclusions to be reached on anything.

16.2.5 The activities of the research vessel(s) should be planned in advance, for the coming year. The planning and conduct of cruise programmes is discussed elsewhere; the main point, at present, is that the activities of the research vessel(s) and other sea-going activities should be planned on the basis not only of the agreed research and development programme, but also of the estimated availability of the vessel and of sea-going scientific and technical staff.

Any alterations to the planned programme should be the subject of consultation and agreement among all concerned.

16.3 Supporting Services

16.3.1 Certain supporting services and facilities must be available in the home port and any other frequently used base. They will include the following:

No: 11212

(a) ship's store
(b) net loft and store
(c) office, with storage space for charts, pilotage books, etc.
(d) workshops
(e) cold stores and chillrooms
(f) instrument workshop and storage space for scientific equipment
(g) motor van and truck
(h) mobile lifting gear.

At the home base, some of these facilities will be available at the main laboratories; whether any but the simplest of facilities is required on the quayside or jetty depends upon the distance from where the ship is berthed to the main laboratories. At other bases it will be necessary to provide the full range of facilities.

Another facility required, at one of the bases, is access to a slipway or drydock.

Once again, the facilities provided in practice are not always adequate and in some cases scarcely exist, with consequent adverse effects on vessel availability and utilization and on the chances of carrying out effective research and development.

16.3.2 A final, practical point is the very great desirability of direct access to the research vessel from a quay or jetty. The carrying of expensive scientific apparatus and delicate components or heavy machine parts across beaches, along river banks, in small boats, up narrow, rickety planks or across two or three other vessels, is to be avoided if at all possible. The best arrangement is for the fishery research vessel to have a berth at a quay or jetty reserved for her exclusive use, with direct access for cars and trucks and if possible in close proximity to the research organization she serves.

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60